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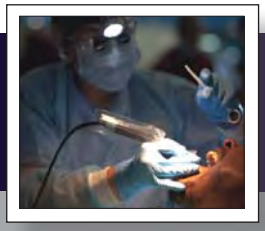

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Associations between Repeated Deployments to OEF/OIF/OND, October 2001-December 2010, and Post-deployment Illnesses and Injuries, Active Component, U.S. Armed Forces

Over the past decade, the U.S. military has conducted continuous wartime operations in Afghanistan (Operation Enduring Freedom [OEF]) and Iraq (Operations Iraqi Freedom/New Dawn [OIF/OND]). During that time, many U.S. military members have deployed to OEF/OIF/OND multiple times; such a high operational tempo over such a long period is unprecedented for the U.S. military.

Military and political leaders, medical policy makers, health care providers, and many others have expressed concerns that suicide risk and other mental disorders may increase with increasing numbers of combat deployments.[1,2] Studies of deployers have documented rates of post-traumatic stress disorder (PTSD), depression, and other psychological problems (e.g., anxiety, acute stress) that were higher among repeat compared to first-time deployers.[3-5]

Other studies have found little evidence of causal relationships between repeat deployments and various health effects (e.g., suicide).[2,6] Several factors may account for the finding. For example, service members who are affected by or significantly concerned regarding the adverse health effects of deployment are relatively less likely to deploy again; as a result, repeat deployers may be generally "healthier" than their never or less frequently deployed counterparts (due to institutional prohibitions and self-selection against repeat deployment). Also, the practical knowledge, skills, techniques, and self-confidence that are acquired during combat-related experiences ("combat seasoning") may increase the physical and psychological "resilience" of deployment veterans compared to their less experienced counterparts.

Narrowly focused studies of the effects of repeated combat deployments are informative; however, the natures, determinants, severities, comorbidity relationships, and usual clinical courses of the physical and psychological effects of repeated combat deployments remain poorly understood. This is the first of a series of *MSMR* reports that will assess relationships between multiple OEF/OIF/OND deployments and near term post-deployment illnesses and injuries. This report summarizes the disease and injury-related experiences of male and female deployers within one year after returning from first through fifth OEF/OIF/OND deployments. Future reports will summarize the experiences of other demographic and military (e.g., service branch, military occupation) subgroups of deployers and will focus on various subgroups of illnesses (e.g., mental disorders, respiratory disorders).

Methods:

The surveillance population included all individuals who deployed to and returned from OEF/OIF/OND one or more times between 1 October 2001 and 31 December 2009 while serving in the active component of the U.S. Armed Forces.

Endpoints of analyses were illnesses and injuries (as defined by 3-digit level codes of the International Classification of Diseases, 9th Revision, Clinical Modifications [ICD-9-CM]) that were diagnosed during hospitalizations or ambulatory visits in U.S. military and civilian (reimbursed care) medical treatment facilities within one year after OEF/OIF/OND deployments and between 1 October 2001 and 31 December 2010.

Each post-deployment period was characterized by the number of prior OEF/OIF/OND deployments of subject deployers while serving in the active component, i.e., post-deployment periods 1 through 5 were defined as 0-12 months following the first through fifth OEF/OIF/OND deployments (of at least 30 days in duration), respectively, of each active component deployer. Each post-deployment period was also characterized by the military and demographic characteristics of the subject deployer (e.g., gender, age group, service branch, military rank, military occupational group), the time period of the deployment (i.e., calendar year of deployment start), and the "dwell time" before each repeat deployment (i.e., time from the end of the preceding to the start of the subject deployment). If "dwell times" between consecutive deployments were less than 30 days, the subject deployments were considered single deployments for analysis purposes.

Cases of illnesses and injuries were ascertained from primary (first-listed) diagnoses on records of hospitalizations and ambulatory visits during relevant post-deployment periods. Regardless of the number of medical encounters for specific conditions during each post-deployment period, each deployer could be counted as a case of each condition only once per post-deployment period. Male-specific conditions (e.g., penis, testicle, prostate) were excluded from analyses of female deployers' experience; female-specific conditions (e.g., cervix, uterus, ovary, pregnancy-related) were excluded from analyses of male deployers' experience.

The proportion of deployers who were diagnosed with various illnesses and injuries ("proportion affected") after first through fifth deployments were the basis of comparisons

of the post-deployment health of deployers. Specifically, the proportion affected by each ICD-9-CM-defined illness and injury within one year after first through fifth deployments was calculated by dividing the number of returned deployers diagnosed with each condition by the number of individuals in the respective post-deployment cohorts. To assess relationships between multiple deployments and the proportion of deployers affected by each illness and injury after deployment, the number per 1,000 deployers who received each condition-specific diagnosis after first OEF/OIF/OND deployments (i.e., the referent experience for all comparisons) was subtracted from the number per 1,000 who received the diagnosis after second through fifth deployments (i.e., the repeat deployment experience). The conditions with the largest positive differences in the proportions affected among repeat compared to first-time deployers were considered those most likely caused or exacerbated by repeat deployment.

For this report, the 20 conditions with the largest differences in the proportions affected between each repeat deployer cohort and all first-time deployers were considered those "most excessive" in the repeat deployer cohorts. Conditions that were among the "most excessive" in at least two of the four repeat deployer cohorts are referred to in this report as "excessive" among repeat deployers.

The numbers of "excess" cases of conditions of interest among repeat (relative to first-time) deployers were estimated by multiplying the differences between the proportions of repeat and first-time deployers who were affected by the conditions by the number of service members in the respective repeat deployer cohorts.

Results:

During the surveillance period, 1,347,731 active component members deployed in support of OEF/OIF/OND. Of all deployers, approximately two of five (40.1%) deployed at least twice, one of eight (12.3%) deployed at least three times, one of thirty (3.5%) deployed at least four times, and one of eighty (1.2%) deployed at least five times **(Table 1)**.

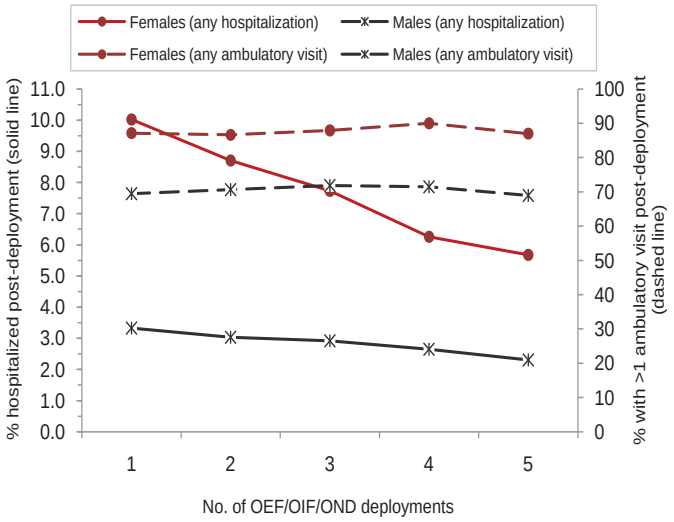
Of all first-time deployers, most were males (88.5%); approximately two-thirds were in the Army (42.1%) or Navy (22.5%); nearly two-thirds were in their twenties (63.9%); nearly one-half were married (45.9%); and approximately one-fourth (26.3%) were in combat-specific occupations. Compared to first-time deployers, veterans of five deployments were more often males (95.7%), ≥30 years old (54.9%), married (66.5%), in the Air Force (53.0%), and in combat-specific occupations (44.3%) **(Table 1)**.

Relatively more females than males were hospitalized within one year after returning from OEF/OIF/OND (% hospitalized after first through fifth deployments, range: females, 10.0-5.7%; males, 3.3-2.3%). With increasing numbers of deployments, the proportions hospitalized

Table 1. Military and demographic characteristics of deployers, by the number of OEF/OIF/OND deployments, active component, U.S. Armed Forces, October 2001-December 2009

	Deployment 1		Deployment 2		Deployment 3		Deployment 4		Deployment 5	
	Number	%	Number	%	Number	%	Number	%	Number	%
Total	1,347,731	100.0	550,722	100.0	165,187	100.0	46,924	100.0	16,697	100.0
Gender										
Male	1,193,195	88.5	502,874	91.3	153,967	93.2	44,432	94.7	15,975	95.7
Female	154,536	11.5	47,848	8.7	11,220	6.8	2,492	5.3	722	4.3
Age group										
<20	132,097	9.8	4,546	0.8	145	0.1	2	0.0	0	0.0
20-24	600,299	44.5	217,122	39.4	41,024	24.8	7,740	16.5	2,363	14.2
25-29	261,368	19.4	141,331	25.7	50,507	30.6	14,929	31.8	5,164	30.9
30-40	294,921	21.9	157,604	28.6	61,386	37.2	20,018	42.7	7,533	45.1
>40	59,046	4.4	30,119	5.5	12,125	7.3	4,235	9.0	1,637	9.8
Service										
Army	567,953	42.1	228,001	41.4	67,335	40.8	17,711	37.7	6,211	37.2
Navy	303,154	22.5	109,420	19.9	25,385	15.4	4,685	10.0	1,055	6.3
Air Force	264,093	19.6	117,562	21.3	49,947	30.2	20,767	44.3	8,844	53.0
Marine Corps	209,366	15.5	95,341	17.3	22,434	13.6	3,733	8.0	574	3.4
Coast Guard	3,165	0.2	398	0.1	86	0.1	28	0.1	13	0.1
Military occupational group										
Combat-specific	354,089	26.3	163,086	29.6	53,254	32.2	17,653	37.6	7,398	44.3
Health care	79,193	5.9	24,034	4.4	5,571	3.4	1,186	2.5	359	2.2
Administration, supply	303,657	22.5	120,934	22.0	34,286	20.8	8,177	17.4	1,999	12.0
Other	610,792	45.3	242,668	44.1	72,076	43.6	19,908	42.4	6,941	41.6
Marital status										
Married	618,793	45.9	314,426	57.1	106,460	64.4	31,075	66.2	11,097	66.5
Other/unknown	728,938	54.1	236,296	42.9	58,727	35.6	15,849	33.8	5,600	33.5
"Dwell time" before deploy										
<183 days	-	0.0	82,397	15.0	34,091	20.6	15,391	32.8	7,416	44.4
183-365 days	-	0.0	137,330	24.9	42,086	25.5	12,737	27.1	4,777	28.6
366-548 days	-	0.0	125,383	22.8	38,599	23.4	9,639	20.5	2,367	14.2
549-730 days	-	0.0	82,115	14.9	20,750	12.6	3,952	8.4	996	6.0
> 730 days	-	0.0	123,497	22.4	29,661	18.0	5,205	11.1	1,141	6.8
Other	1,347,731	100.0	0	0.0	0	0.0	0	0.0	0	0.0

Figure 1. Proportion (%) of deployers with any hospitalization or any ambulatory visit (illness- or injury-related) within one year after returning from an OEF/OIF/OND deployment, by the number of OEF/OIF/OND deployments, active component members, U.S. Armed Forces, October 2001-December 2010



sharply declined among females but only slightly declined among males **(Figure 1).** Similarly, relatively more females than males had at least one illness or injury-related ambulatory visit within one year after returning from OEF/OIF/OND (% with an illness or injury-related ambulatory visit after first through fifth deployments, range: females, 87.1-90.0%; males, 69.5-71.8%). Among both males and females, the proportions with at least one post-deployment ambulatory visit did not vary based on the number of prior deployments **(Figure 1).**

Males

Among males, for most conditions, the proportions of repeat deployers and first-time deployers who were affected by the conditions were very similar. Of the conditions that affected markedly different proportions of repeat and first-time deployers, the number that affected higher proportions of repeat deployers was similar to the number that affected higher proportions of first-time deployers **(data not shown).**

Among males, there were significant overlaps among the conditions that were "most excessive" in each repeat deployer cohort. Twenty-four conditions were among the 20 "most excessive" in at least two of the four repeat deployer cohorts; these conditions are referred to as "excessive" among repeat deployers for the remainder of this report **(Table 2, Figures 2a-d).**

The 24 "excessive" conditions among male repeat (relative to first-time) deployers included (in no particular order) mental disorders (anxiety, dissociative, somatoform disorders; adjustment reactions [including post-traumatic stress disorder]); respiratory conditions (acute upper respiratory infections of multiple/unspecified sites; chronic sinusitis; allergic rhinitis; symptoms involving respiratory system and other chest symptoms); neck and back disorders (spondylosis and allied disorders; intervertebral disc disorders; other disorders of cervical region; other and unspecified disorders of the back); musculoskeletal disorders (peripheral enthesopathies and allied syndromes; nonallopathic lesions, not elsewhere classified); and various nonspecific conditions (neoplasm of uncertain behavior of other and unspecified sites/tissues; general symptoms; nonspecific abnormal results of function studies; other nonspecific abnormal findings). Organic sleep disorders, hearing loss, disorders of lipoid metabolism (including hypercholesterolemia and hyperlipidemia), essential hypertension, and benign neoplasms of skin were also "excessive" among repeat compared to first-time deployers **(Table 2, Figures 2a-d).**

Of the 24 "excessive" conditions among male repeat deployers, ICD-9-CM 719 "other and unspecified disorders of joints" and ICD-9-CM 724 "other and unspecified disorders of the back" affected the largest proportions by far of each repeat deployment cohort **(Figure 3).** These conditions also accounted for the largest excess numbers of cases (relative to first-time deployers) after second and third deployments; ICD-9-CM 272 "disorders of lipoid metabolism" accounted for the largest excess numbers of cases after fourth and fifth deployments **(Table 2).**

For six of the 24 "excessive" conditions among repeat deployers, the proportions affected consistently increased with each additional deployment (benign neoplasms of skin; neoplasms of uncertain behavior of other and unspecified sites/tissues; disorders of lipoid metabolism; chronic sinusitis; allergic rhinitis; and nonallopathic lesions, not elsewhere classified). For nearly all other "excessive" conditions, the proportions affected increased from the first through third deployments and then were stable or declined after fourth and fifth deployments **(Figure 3).**

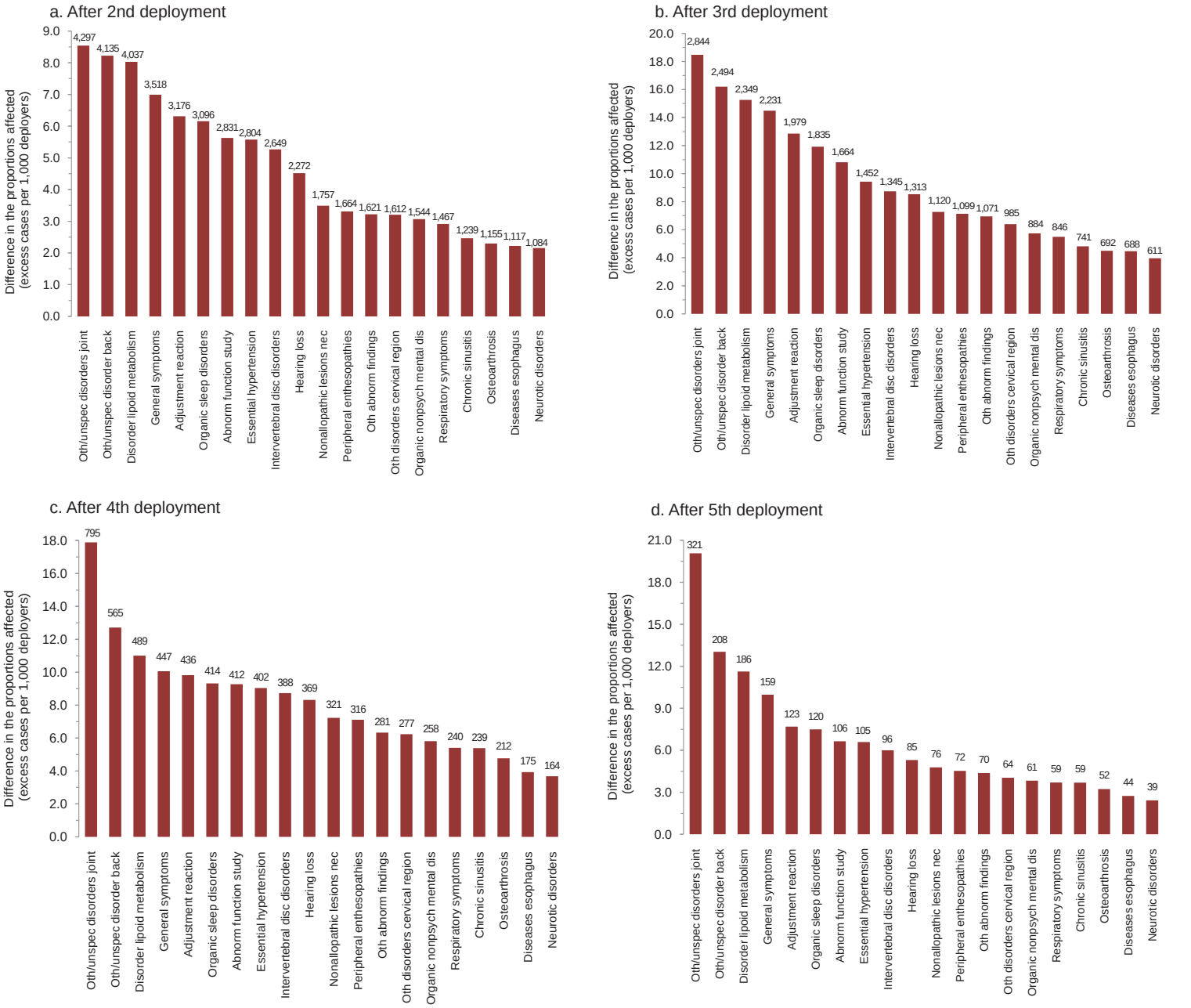
Females

As among males, for most conditions among females, the proportions of repeat and first-time deployers who were affected by the conditions were very similar. Of the conditions that affected markedly different proportions of repeat and first-time deployers, the number that affected higher proportions of repeat deployers was similar to the number that affected higher proportions of first-time deployers **(data not shown).**

Among females, there were significant overlaps among the conditions that were "most excessive" in each repeat deployer cohort. Twenty-five conditions were among the 20 "most excessive" in at least two of the four repeat deployer cohorts; these conditions are referred to as "excessive" among repeat deployers for the remainder of this report **(Table 3, Figures 4a-d).**

The 25 "excessive" conditions among female repeat deployers included (in no particular order) respiratory conditions (acute upper respiratory infections of multiple/unspecified

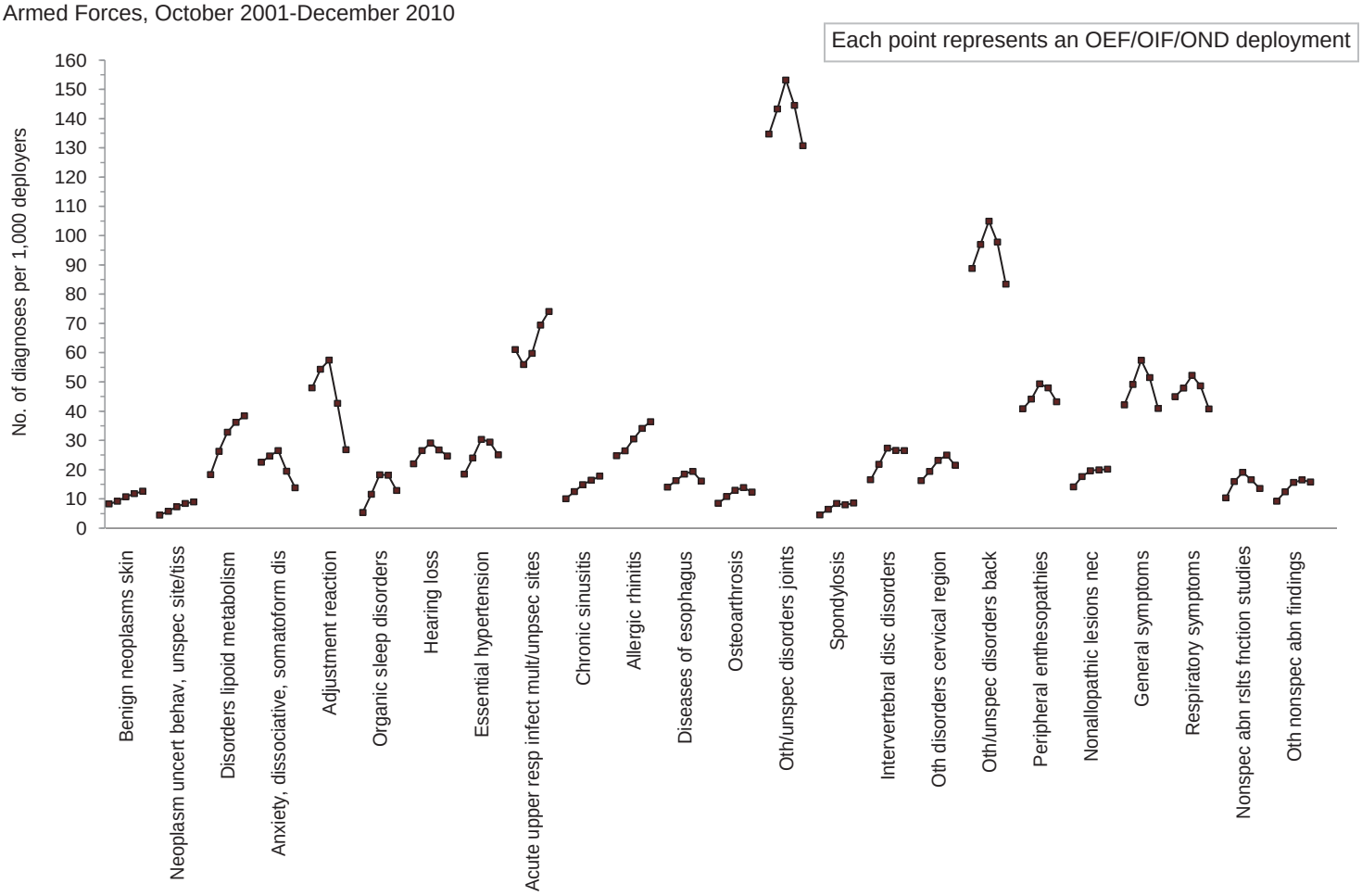
Figure 2 a-d. Illnesses and injuries with the largest differences in the proportions affected after repeat compared to first OEF/OIF/OND deployments, male active component members, U.S. Armed Forces, October 2001-December 2010



sites; chronic sinusitis; allergic rhinitis); neck and back disorders (spondylosis and allied disorders; intervertebral disc disorders; other disorders of cervical region); musculoskeletal disorders (other and unspecified disorders of joints; peripheral enthesopathies and allied syndromes; disorders of muscle, ligament, and fascia; nonallopathic lesions, not elsewhere classified); and various nonspecific conditions (neoplasm of uncertain behavior of other and unspecified sites/tissues; other headache syndromes; general symptoms; other nonspecific abnormal findings). "Special symptoms or syndromes, not elsewhere classified" (includes nonorganic sleep disorders); organic sleep disorders; acquired hypothyroidism; disorders of lipoid metabolism (includes hypercholesterolemia and hyperlipidemia); overweight, obesity, and other hyperalimentation; essential hypertension; uterine leiomyoma; female infertility; diseases of sebaceous glands; benign neoplasms of skin; and disorders of refraction and accommodation were also "excessive" among repeat compared to first-time deployers **(Table 3, Figures 4a-d).**

Of the 25 "excessive" conditions among female repeat deployers, ICD-9-CM 367 "disorders of refraction and accommodation," ICD-9-CM 719 "other and unspecified disorders of joints," and ICD-9-CM 465 "acute upper respiratory infections, multiple/unspecified sites" affected the largest proportions of each repeat deployer cohort **(Figure 5).** ICD-9-CM 401 "essential hypertension," ICD-9-CM 719

Figure 3. Proportions of deployers affected by various conditions (cases per 1,000 deployers), after first through fifth OIF/OEF/OND deployments, for conditions considered "excessive" among repeat relative to first-time deployers, male active component members, U.S. Armed Forces, October 2001-December 2010



"other and unspecified disorders of joints," ICD-9-CM 367 "disorders of refraction and accommodation," and ICD-9-CM 477 "allergic rhinitis," accounted for the largest excess numbers of cases after second through fifth deployments, respectively **(Table 3, Figure 4a-d).**

For five of the 25 "excessive" conditions among female repeat deployers, the proportions affected consistently increased with each additional deployment (neoplasms of uncertain behavior of other and unspecified sites/tissues; disorders of lipoid metabolism; allergic rhinitis; female infertility; and nonallopathic lesions, not elsewhere classified). For most of the other "excessive" conditions, the proportions affected increased from the first through the third or fourth deployments and then declined **(Figure 5).**

Editorial comment:

This report provides a comprehensive overview of associations between illnesses and injuries of all types and numbers of OEF/OIF/OND deployments. The findings provide unique insights into health risks associated with repeat deployments during a long war fighting period. For most illnesses and injuries, the proportions of deployers affected within one year after deployment hardly varied in relation to the number of prior deployments. Also, in general, the number of conditions that were relatively excessive among repeat compared to first-time deployers was similar to the number that were relatively excessive among first-time compared to repeat deployers.

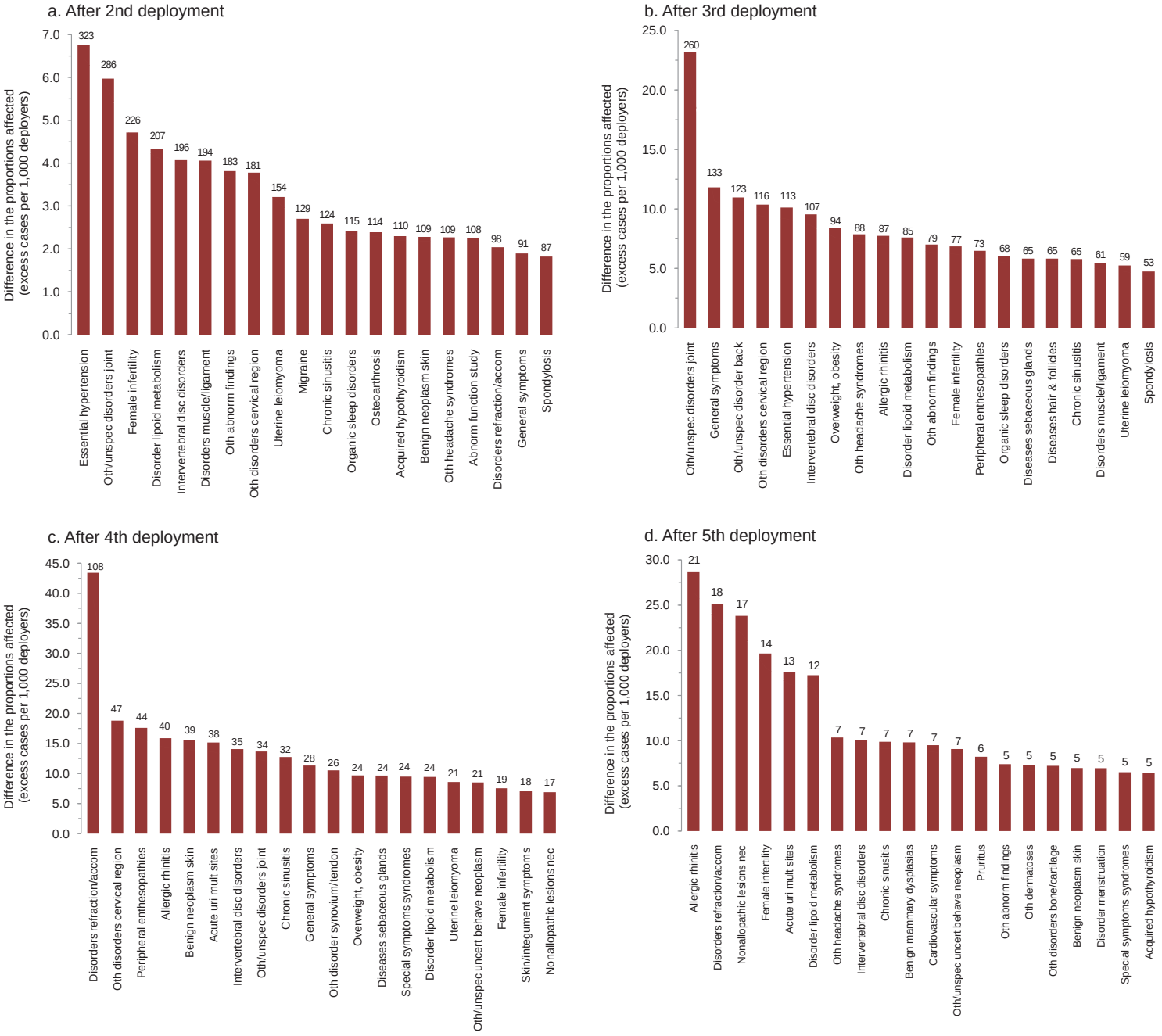
Throughout the period of OEF/OIF/OND, first and second time deployers compared to three or more time deployers have been younger, lower in grade, and more likely assigned to ground (e.g., Army, Marine Corps) than air or sea services. In general, in both Iraq and Afghanistan, junior grade deployers in ground combat occupations have been at greater risk of disabling combat injuries than their more senior air and sea service counterparts. Deployers who sustain disabling combat injuries may not be able to continue active service or deploy again. As a result, the proportions of deployment veterans who have disabling combat injuries (e.g., wounds, amputations, severe traumatic brain injuries) do not increase – and generally decline – after repeat compared to first deployments.

Of note, no mental disorder-specific diagnoses among females and no depression-specific diagnoses among males were among the most excessive diagnoses among repeat

Table 2. Twenty "most excessive" conditions after 2nd through 5th compared to first OEF/OIF/OND deployments, among males, active component, U.S. Armed Forces, October 2001-December 2010

ICD-9-CM Illness/injury	No. affected	Proportion affected (cases per 1,000 deployers)	Differences in proportion affected, repeat v. first deployment	"Excess" cases among repeat deployers	ICD-9-CM Illness/injury	No. affected	Proportion affected (cases per 1,000 deployers)	Differences in proportion affected, repeat v. first deployment	"Excess" cases among repeat deployers
After second deployment					**After third deployment**				
719 Oth/unspec disorders joint	72,049	143.3	8.5	4,297	719 Oth/unspec disorders joint	23,588	153.2	18.5	2,844
724 Oth/unspec disorder back	48,773	97.0	8.2	4,135	724 Oth/unspec disorder back	16,161	105.0	16.2	2,494
272 Disorder lipoid metabolism	13,240	26.3	8.0	4,037	780 General symptoms	8,839	57.4	15.3	2,349
780 General symptoms	24,714	49.1	7.0	3,518	272 Disorder lipoid metab	5,049	32.8	14.5	2,231
309 Adjustment reaction	27,314	54.3	6.3	3,176	327 Organic sleep disorders	2,811	18.3	12.9	1,979
327 Organic sleep disorders	5,812	11.6	6.2	3,096	401 Essential hypertension	4,677	30.4	11.9	1,835
794 Nonspec abn results fct studies	8,037	16.0	5.6	2,831	722 Intervertebral disc disorders	4,215	27.4	10.8	1,664
401 Essential hypertension	12,085	24.0	5.6	2,804	309 Adjustment reaction	8,842	57.4	9.4	1,452
722 Intervertebral disc disorders	10,980	21.8	5.3	2,649	794 Nonspec abn results fct studies	2,939	19.1	8.7	1,345
389 Hearing loss	13,328	26.5	4.5	2,272	726 Peripheral enthesopathies	7,599	49.4	8.5	1,313
739 Nonallopathic lesions nec	8,872	17.6	3.5	1,757	786 Symptoms respiratory sys and chest	8,045	52.2	7.3	1,120
726 Peripheral enthesopathies	22,195	44.1	3.3	1,664	389 Hearing loss	4,484	29.1	7.1	1,099
796 Oth nonspec abnorm findings	6,269	12.5	3.2	1,621	723 Oth disorders cervical region	3,570	23.2	7.0	1,071
723 Oth disorders cervical region	9,775	19.4	3.2	1,612	796 Oth nonspec abnorm findings	2,408	15.6	6.4	985
310 Nonpsych mental p brain dmg	4,083	8.1	3.1	1,544	477 Allergic rhinitis	4,702	30.5	5.7	884
786 Symptoms respiratory sys chest	24,085	47.9	2.9	1,467	739 Nonallopathic lesions nec	3,024	19.6	5.5	846
473 Chronic sinusitis	6,308	12.5	2.5	1,239	473 Chronic sinusitis	2,293	14.9	4.8	741
715 Osteoarthrosis allied dis	5,428	10.8	2.3	1,155	715 Osteoarthrosis	2,000	13.0	4.5	692
530 Diseases esophagus	8,167	16.2	2.2	1,117	530 Diseases esophagus	2,846	18.5	4.5	688
300 Anxiety dissoc somatoform dis	12,415	24.7	2.2	1,084	300 Anxiety dissoc somatoform dis	4,080	26.5	4.0	611
After fourth deployment					**After fifth deployment**				
272 Disorder lipoid metabolism	1,608	36.2	17.9	795	272 Disorder lipoid metabolism	613	38.4	20.1	321
327 Organic sleep disorders	805	18.1	12.7	565	465 Acute upper resp inf mult unspec sites	1,184	74.1	13.0	208
401 Essential hypertension	1,309	29.5	11.0	489	477 Allergic rhinitis	582	36.4	11.6	186
722 Intervertebral disc disorders	1,183	26.6	10.1	447	722 Intervertebral disc disorders	424	26.5	10.0	159
719 Oth/unspec disorders joint	6,423	144.5	9.8	436	473 Chronic sinusitis	284	17.8	7.7	123
780 General symptoms	2,287	51.5	9.3	414	327 Organic sleep disorders	206	12.9	7.5	120
477 Allergic rhinitis	1,514	34.1	9.3	412	401 Essential hypertension	401	25.1	6.6	106
724 Oth/unspec disorder back	4,346	97.8	9.0	402	796 Oth nonspec abnorm findings	253	15.8	6.6	105
723 Oth disorders cervical region	1,109	25.0	8.7	388	739 Nonallopathic lesions nec	322	20.2	6.0	96
465 Acute upper resp inf mult unspec sites	3,083	69.4	8.3	369	723 Oth disorders cervical region	344	21.5	5.3	85
796 Oth nonspec abnorm findings	732	16.5	7.2	321	702 Oth dermatoses	122	7.6	4.8	76
726 Peripheral enthesopathies	2,130	47.9	7.1	316	238 Neoplasm uncert behave unsp site tiss	144	9.0	4.5	72
473 Chronic sinusitis	729	16.4	6.3	281	216 Benign neoplasm skin	202	12.6	4.4	70
794 Nonspec abn results fct studies	737	16.6	6.2	277	721 Spondylosis	137	8.6	4.0	64
739 Nonallopathic lesions nec	887	20.0	5.8	258	715 Osteoarthrosis	197	12.3	3.8	61
530 Diseases esophagus	863	19.4	5.4	240	460 Acute nasopharyngitis	212	13.3	3.7	59
715 Osteoarthrosis	617	13.9	5.4	239	381 Nonsupp otitis media eust tube dis	141	8.8	3.7	59
389 Hearing loss	1,189	26.8	4.8	212	794 Nonsp abn results func studies	217	13.6	3.2	52
238 Neoplasm uncert behave unsp site tiss	374	8.4	3.9	175	389 Hearing loss	395	24.7	2.7	44
786 Symptoms respiratory sys chest	2,162	48.7	3.7	164	726 Peripheral enthesopathies	691	43.2	2.4	39

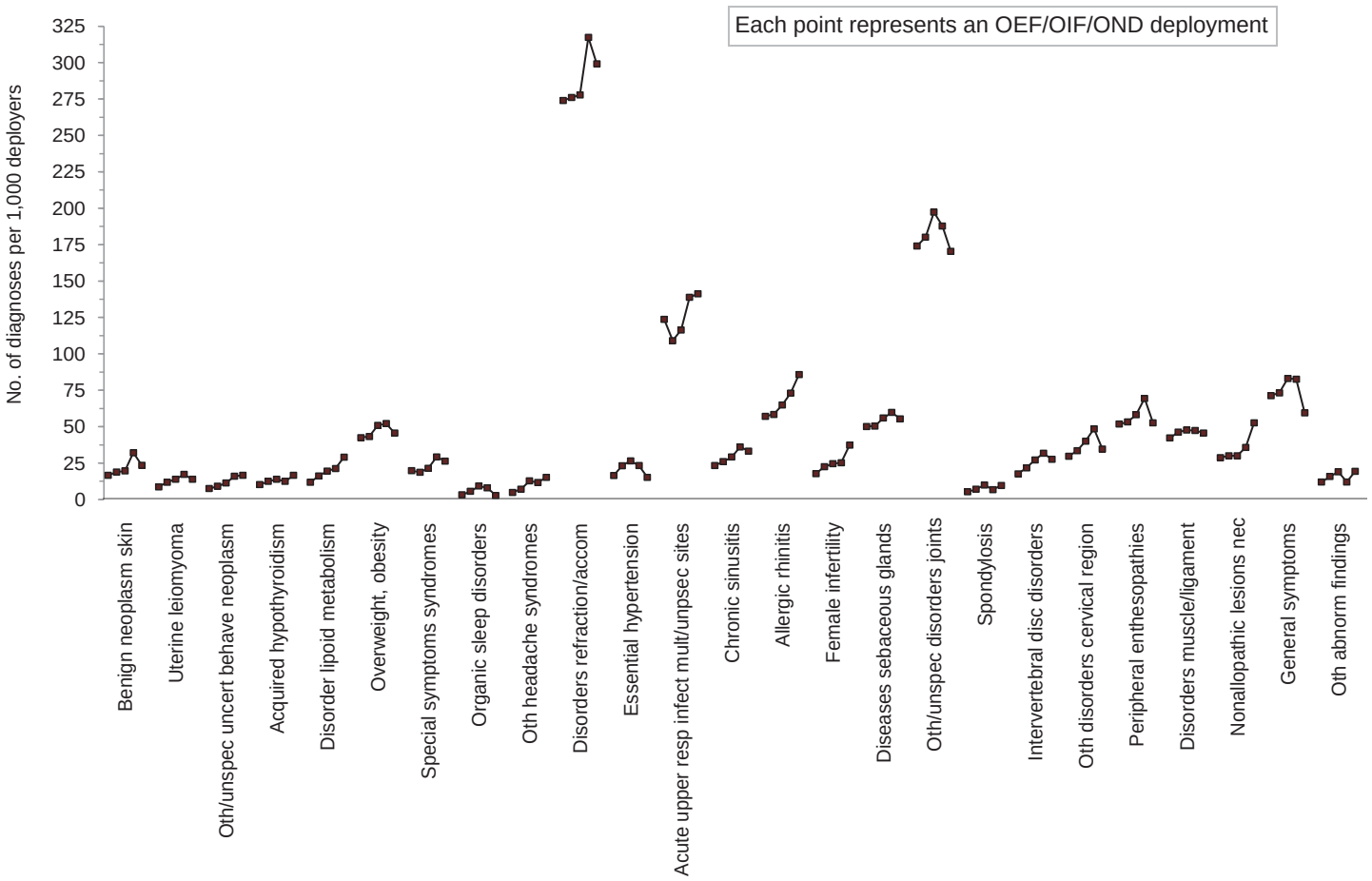
Figure 4 a-d. Illnesses and injuries with the largest differences in the proportions affected after repeat compared to first OEF/OIF/OND deployments, female active component members, U.S. Armed Forces, October 2001-December 2010



compared to first-time deployers. Many service members who are affected by mental disorders after OEF/OIF/OND deployments leave active service or are medically ineligible to deploy again. As a result, as a group, service members who have deployed multiple times may be more psychologically resilient to deployment stress-related symptoms than their never or less frequently deployed counterparts. There are widespread concerns that repeated deployments may increase risks of mental disorders (e.g., depression, PTSD) and suicide. However, the findings of this report reiterate the importance of providing mental health-related interventions – including suicide prevention – during and closely following the first wartime deployments of both male and female service members.

In general, repeat deployers are older and more senior in grade than first-time deployers; as such, repeat deployers may undergo more frequent (e.g., pre- and post- deployment health assessments) and more focused (age-related cardiovascular screening) health assessments than younger and more junior first-time deployers. In addition, behaviors (e.g., diet, sleep, exercise, non-smoking) that enhance health are often disrupted during deployments. Thus, it is not surprising that some conditions associated with aging and unhealthy behaviors are detected more frequently among

Figure 5. Proportions of deployers affected by various conditions (cases per 1,000 deployers), after first through fifth OIF/OEF/OND deployments, for conditions considered "excessive" among repeat relative to first-time deployers, female active component members, U.S. Armed Forces, October 2001-December 2010



repeat than first-time deployers; such conditions include overweight/obesity, hypertension, hypercholesterolemia, hyperlipidemia, and some sleep disorders. To the extent possible, given operational constraints, healthy behaviors should be encouraged while service members are deployed.

It is also not surprising that conditions that are directly caused or exacerbated by war-related experiences – but do not constitute impediments to continued military service or repeat deployment – increase in prevalence with increasing numbers of deployments; hearing loss is an example of such a condition.

This and other reports document increasing prevalences of neck, back, and other musculoskeletal disorders with increasing deployments. Repeat deployers are older than first-time deployers; the relatively high prevalences of some musculoskeletal disorders among repeat deployers likely reflect, at least in part, the general effects of aging. In addition, higher prevalences of certain musculoskeletal disorders may manifest the effects of high load bearing (e.g., body armor, helmet, water, rations, weapon, ammunition, other supplies/equipment) and extreme neck and back stresses during prolonged, sustained, and physically demanding operational activities (e.g., long range military vehicle travel, fixed and rotary wing air travel, foot patrols in rugged terrain). More research is indicated to characterize the natures, causes, and risk factors for musculoskeletal disorders that are associated with wartime deployment.

This analysis documented that relatively more repeat than first-time deployers were affected by chronic sinusitis, upper respiratory infections, and allergic rhinitis after deployment. Since the First Gulf War in the early 1990s, there have been concerns regarding potential adverse effects on the respiratory system from, for example, civilian and military industrial pollutants; military activity-related smokes, vapors, and other products of combustion; initiation of tobacco smoking; ambient dust and sand; prolonged exposures to arid environments; and others.[7-12] It is unclear which of these, if any, are related to the specific conditions that were identified as "excessive" among repeat deployers in this analysis. Many studies have examined these and other hypothesized threats to respiratory health; more research in this area is indicated.

Finally, there are significant limitations to this report that should be considered when interpreting the results. For example, the demographic and military characteristics of

Table 3. Twenty most excessive conditions among females, after 2nd through 5th compared to first OEF/OIF/OND deployments, active component, U.S. Armed Forces, October 2001-December 2010

ICD-9-CM Illness/injury	No. affected	Proportion affected (cases per 1,000 deployers)	Differences in proportion affected, repeat v. first deployment	"Excess" cases among repeat deployers	ICD-9-CM Illness/injury	No. affected	Proportion affected (cases per 1,000 deployers)	Differences in proportion affected, repeat v. first deployment	"Excess" cases among repeat deployers
After second deployment					**After third deployment**				
401 Essential hypertension	1,110	23.2	6.8	323	719 Oth unspec dis joint	2,214	197.3	23.2	260
719 Oth/unspec disorders joint	8,618	180.1	6.0	286	780 General symptoms	933	83.2	11.8	133
628 Female infertility	1,075	22.5	4.7	226	724 Oth unspec disorder back	1,643	146.4	11.0	123
272 Disorder lipoid metabolism	773	16.2	4.3	207	723 Oth disorders cervical region	450	40.1	10.4	116
722 Intervertebral disc disorders	1,040	21.7	4.1	196	401 Essential hypertension	298	26.6	10.1	113
728 Dis muscle ligament fascia	2,215	46.3	4.1	194	722 Intervertebral disc disorders	305	27.2	9.5	107
796 Oth abnorm findings	756	15.8	3.8	183	278 Overweight obesity oth hyperaliment	571	50.9	8.4	94
723 Oth disorders cervical region	1,604	33.5	3.8	181	339 Oth headache syndromes	143	12.7	7.9	88
218 Uterine leiomyoma	568	11.9	3.2	154	477 Allergic rhinitis	728	64.9	7.7	87
346 Migraine	2,317	48.4	2.7	129	272 Disorder lipoid metabolism	218	19.4	7.6	85
473 Chronic sinusitis	1,242	26.0	2.6	124	796 Oth nonspec abnorm findings	213	19.0	7.0	79
327 Organic sleep disorders	269	5.6	2.4	115	628 Female infertility	276	24.6	6.9	77
715 Osteoarthrosis	542	11.3	2.4	114	726 Peripheral enthesopathies	654	58.3	6.5	73
244 Acquired hypothyroidism	597	12.5	2.3	110	327 Organic sleep disorders	104	9.3	6.1	68
216 Benign neoplasm skin	902	18.9	2.3	109	706 Diseases sebaceous glands	628	56.0	5.8	65
339 Oth headache syndromes	342	7.1	2.3	109	704 Diseases hair & follicles	263	23.4	5.8	65
794 Nonspec abn reslts fctn study	478	10.0	2.3	108	473 Chronic sinusitis	327	29.1	5.8	65
367 Disorders refraction/accom	13,208	276.0	2.0	98	728 Disorders muscle ligament fascia	535	47.7	5.4	61
780 General symptoms	3,504	73.2	1.9	91	218 Uterine leiomyoma	156	13.9	5.2	59
721 Spondylosis	338	7.1	1.8	87	721 Spondylosis	112	10.0	4.7	53
After fourth deployment					**After fifth deployment**				
367 Disorders refraction/accom	791	317.4	43.4	108	477 Allergic rhinitis	62	85.9	28.7	21
723 Oth disorders cervical region	121	48.6	18.8	47	367 Disorders refraction/accom	216	299.2	25.2	18
726 Peripheral enthesopathies	173	69.4	17.6	44	739 Nonallopathic lesions nec	38	52.6	23.8	17
477 Allergic rhinitis	182	73.0	15.9	40	628 Female infertility	27	37.4	19.6	14
216 Benign neoplasm skin	80	32.1	15.5	39	465 Acute upper resp inf mult unspec sites	102	141.3	17.6	13
465 Acute upper resp inf mult unspec sites	346	138.8	15.2	38	272 Disorder lipoid metabolism	21	29.1	17.3	12
722 Intervertebral disc disorders	79	31.7	14.1	35	339 Oth headache syndromes	11	15.2	10.4	7
719 Oth/unspec disorders joint	468	187.8	13.7	34	722 Intervertebral disc disorders	20	27.7	10.1	7
473 Chronic sinusitis	90	36.1	12.8	32	473 Chronic sinusitis	24	33.2	9.9	7
780 General symptoms	206	82.7	11.3	28	610 Benign mammary dysplasias	13	18.0	9.8	7
727 Oth disorder synovium/tendon	115	46.1	10.5	26	785 Cardiovascular symptoms	21	29.1	9.5	7
278 Overweight obesity oth hyper aliment	130	52.2	9.7	24	238 Neoplasm uncert behav unsp site tissue	12	16.6	9.1	7
706 Diseases sebaceous glands	149	59.8	9.6	24	698 Pruritus	10	13.9	8.2	6
307 Special symptoms syndromes nec	73	29.3	9.5	24	796 Oth abnorm findings	14	19.4	7.4	5
272 Disorder lipoid metabolism	53	21.3	9.4	24	702 Oth dermatoses	8	11.1	7.3	5
218 Uterine leiomyoma	43	17.3	8.6	21	733 Oth disorders bone/cartilage	20	27.7	7.2	5
238 Neoplasm uncert behav unsp site tissue	40	16.1	8.5	21	216 Benign neoplasm skin	17	23.5	7.0	5
628 Female infertility	63	25.3	7.5	19	626 Disorder menstruation	53	73.4	7.0	5
782 Symptoms skin oth integument	115	46.1	7.1	18	307 Special symptoms syndromes nec	19	26.3	6.5	5
739 Nonallopathic lesions nec	89	35.7	6.9	17	244 Acquired hypothyroidism	12	16.6	6.4	5

initial and repeat deployers are markedly different. However, the results reported here do not control for the effects of these differences; such effects could alter some findings and interpretations.

Also, case-defining diagnoses for this report were ascertained from ICD-9-CM 3-digit level codes that were reported on standardized records of hospitalizations and ambulatory visits. In some cases, diagnoses at the 3-digit level are relatively uninformative regarding conditions of particular interest (e.g., "post-traumatic stress disorder" is included under ICD-9-CM 309 "adjustment reaction"; "nonorganic sleep disorder" is included under ICD-9-CM 307 "special symptoms or syndromes, not elsewhere classified").

In addition, this analysis summarizes the experiences of active component members only. However, the experiences of repeat deployers who remain in active service – the subjects of this report – likely vary from those of deployment veterans who leave active service and repeat deployers from the reserve components. Therefore, the experiences summarized in this report may not reliably represent the experiences of all OEF/OIF/OND veterans.

Finally, conditions with long asymptomatic early stages ("long latency periods") and/or chronic or relapsing clinical courses may have disease causing exposures and disease process onsets that precede the initial clinical manifestations of the conditions by years or decades. Yet, in this analysis, the natures and dates of likely or plausible causal exposures, the dates of the clinical onsets of conditions, and the pre-deployment medical histories of cases were not accounted for. It is important to keep in mind that conditions diagnosed within one year after deployment are temporally related to, but not necessarily caused or even exacerbated by, experiences or exposures during deployment. Consider the example of a long time cigarette smoker with a family history of heart disease who is diagnosed with chronic bronchitis, cardiovascular disease, and lung cancer within one year after a deployment; in this case, the conditions diagnosed after deployment would more likely be related to pre-deployment smoking and other pre-existing risk factors than deployment-related exposures.

In summary, the findings of this analysis illuminate some general points regarding the health effects of repeat deployments. Most important perhaps, the conditions that are most likely to increase in prevalence among repeat deployers are those that a) are caused or exacerbated by deployment-related exposures or activities and/or are strongly associated with aging (throughout the young adult years); b) have long lasting or relapsing clinical courses; and c) do not preclude (e.g., due to medical disability) or discourage (e.g., voluntary termination of service) continued military service or repeat deployments. In turn, conditions that are caused or exacerbated by deployment-related exposures but preclude continued military service or repeat deployments (e.g., battle injuries, severe TBI, debilitating PTSD) are unlikely to increase in prevalence among repeat deployers.

Of note, the findings and interpretations expressed in this report should be validated before they are incorporated into policies or practices. For example, medical histories, deployment experiences (e.g., personal injuries; causing/witnessing physical violence), and the effects of potentially confounding factors (e.g., age, service branch, occupation) should be accounted for in future studies of the health effects of repeat deployments. Also, future studies should focus on defining the natures and determinants of physical and psychological "resilience" in relation to repeat deployments; in particular, studies should determine whether repeat deployments select for the most inherently resilient service members, incrementally increase the resilience of repeat deployers, or both.

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Carpal Tunnel Syndrome, Active Component, U.S. Armed Forces, 2000-2010

Carpal Tunnel Syndrome (CTS) is a pathologic condition involving compression of the median nerve as it passes through the bones of the wrist. Compression of the median nerve causes symptoms such as pain, numbness, weakness, and paresthesia in the hand and wrist and may radiate up the arm.[1] CTS is the most common form of compressive neuropathy and can cause significant work-related disability.[2-4] Causes of CTS involve many factors including congenital predisposition, injury or trauma, specific endocrine conditions, movements involving high repetition, awkward positioning, and repeated use of vibrating machinery.[1,5] Advancing age and female gender are the two most noted risk factors of CTS.[1,6,7]

In the general population the incidence of CTS remains variable; estimates of incidence range from 1.5 to 3.5 per 1,000 person-years (p-yrs).[2,8,9] In a previous report, the *MSMR* estimated the incidence rate of CTS in active duty soldiers from 1998-1999 as 5.1 per 1,000 p-yrs; rates were 3 times higher in women than men and increased steadily with age.[10] A 2009 study of the military population from 1998-2006 estimated an incidence rate of 4.0 per 1,000 p-yrs.[11]

CTS remains a major cause of disability in the work force.[3,4] It presents a substantial burden associated with treatment, disability, and potential for separation from the military. It negatively affects military readiness by prohibiting service members from performing their duties as required. This report aims to describe the incidence of CTS among active component US military personnel from 2000 to 2010 and the burden of CTS on the military medical system.

Methods:

The surveillance period was 1 January 2000 to 31 December 2010. The surveillance population consisted of all individuals who served in an active component of any branch of the U.S. military at any time during the surveillance period. Records of all outpatient encounters of active component members in fixed U.S. military and some non-military (i.e., purchased care) medical facilities were searched to identify individuals with diagnoses specific for CTS. An incident case of CTS was defined as a service member with at least two diagnoses of carpal tunnel syndrome (ICD-9-CM code: 354.0) in an outpatient setting with at least one diagnosis in the primary diagnostic position. Date of onset was considered the date of the earliest medical encounter that was contributory to the definition of a CTS case; each individual was considered an incident case only once during the surveillance period. Individuals who received a diagnosis of CTS in any medical setting prior to 1 January 2000 were excluded from the analysis.

The length of time from the first outpatient encounter with a diagnosis of CTS in any diagnostic position to the first procedure for acupuncture, joint injection, or carpal tunnel release surgery was used as an indicator of the morbidity burden associated with CTS. Procedure codes were only available from encounters at military medical facilities.

Results:

During the period, there were 27,738 incident cases of CTS and an overall crude incidence rate of 1.71 per 1,000 p-yrs **(Table 1)**. From 2000 to 2010, numbers of individuals with and incidence rates of CTS decreased by over one-third (2000: n=3,049, rate=2.17 per 1,000 p-yrs; 2010: n=2,005; rate=1.37 per 1,000 p-yrs) **(Figure 1)**.

The 11-year rate was 3.3 times higher among females than males and 18.9 times higher among those 40 years and older than those younger than 20 years. Incidence rates consistently increased with increasing age; the rate of increase accelerated in groups aged 30 years and older **(Table 1)**.

Overall, the incidence rate of CTS was higher among black, non-Hispanic service members than those of other race-ethnicities **(Table 1)**. Among males, there was little variability in incidence rates across racial/ethnic subgroups; however, among females, rates were higher among black, non-Hispanic women (4.65 per 1,000 p-yrs) than their counterparts (e.g., white, non-Hispanic women: 4.02 per 1,000 p-yrs) **(data not shown)**.

Among the Services, the overall incidence rate of CTS was highest in the Air Force and lowest in the Marine Corps (2.48 and 0.66 per 1,000 p-yrs, respectively). Also, in all age and gender-defined subgroups, incidence rates were highest in

Figure 1. Incident counts and incidence rates of carpal tunnel syndrome, active component, U.S. Armed Forces, 2000-2010

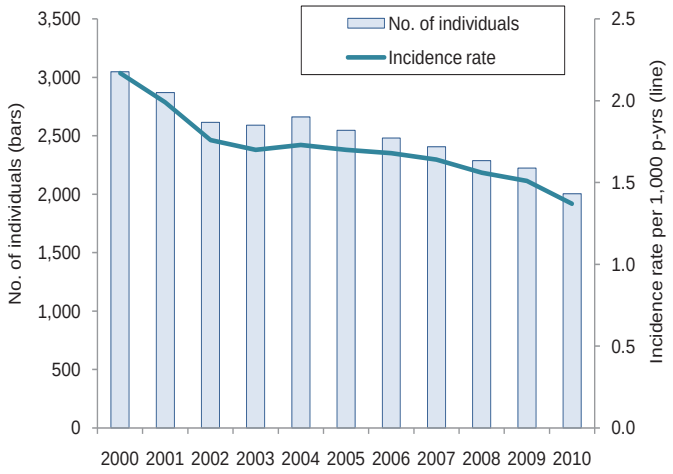


Table 1. Incident counts and incidence rates of carpal tunnel syndrome, active component, U.S. Armed Forces, 2000-2010

	No.	Rate[a]	IRR[b]
Total	27,738	1.71	.
Sex			
Male	17,486	1.27	Ref
Female	10,252	4.18	3.29
Age			
<20	463	0.29	Ref
20-24	4,248	0.78	2.69
25-29	4,675	1.39	4.79
30-34	4,100	1.72	5.93
35-39	6,292	3.08	10.62
40+	7,960	5.47	18.86
Race/ethnicity			
White, non-Hispanic	16,798	1.65	1.08
Black, non-Hispanic	5,885	2.03	1.33
Hispanic	2,497	1.53	Ref
American Indian/Alaskan Native	410	1.55	1.01
Asian/Pacific Islander	1,215	1.66	1.08
Other	189	1.56	1.02
Unknown race	744	2.03	1.33
Service			
Army	10,011	1.72	2.61
Navy	5,752	1.45	2.20
Air Force	9,783	2.48	3.76
Marine Corps	1,353	0.66	Ref
Coast Guard	839	1.89	2.86
Rank			
Junior enlisted (E1-E4)	6,743	0.95	Ref
Senior enlisted (E5-E9)	16,607	2.55	2.68
Junior officers (O1-O3 [W1-W3])	1,918	1.19	1.25
Senior officers (O4-O10 [W4-W5])	2,470	2.41	2.54
Occupation (Enlisted)			
Infantry, gun crews, seamanship specialists	2,166	0.93	2.16
Electronic repairers	1,768	1.50	3.49
Communications & intell specialists	1,843	1.48	3.44
Health care specialists	2,577	2.79	6.49
Other technical & allied specialists	779	1.84	4.28
Functional support & admin	6,383	2.98	6.93
Electrical/mechanical equip repairers	4,391	1.60	3.72
Craftsworkers	1,002	1.92	4.47
Service & supply handlers	2,087	1.62	3.77
Non-occupational	329	0.43	Ref
Enlisted, unk occ	25	0.90	2.09
Occupation (Officer)			
General officers & execs, NEC	49	2.19	7.82
Tactical operations officers	822	0.88	3.14
Intell officers	248	1.76	6.29
Engineering & maintenance officers	723	1.96	7.00
Scientists & professionals	271	1.99	7.11
Health care officers	1,192	2.88	10.29
Administrators	485	2.78	9.93
Supply, procurement & allied officers	441	1.99	7.11
Non-occupational	43	0.28	Ref
Officer, unk occ	114	1.54	5.50

[a]Rate per 1,000 person-years of active component military service
[b]Incidence Rate Ratio

the Air Force and lowest in the Marine Corps; the differences across the Services sharply increased in age groups older than 24 years **(Figure 2)**. From 2000 to 2010, crude incidence rates decreased in the Air Force, Navy, and Army (by 87%, 70%, and 45%, respectively). In the Marine Corps, incidence rates remained low and stable throughout the period. In the Coast Guard, annual incidence rates peaked in 2006 (2.35 per 1,000 p-yrs) and then decreased through 2010 (1.04 per 1,000 p-yrs) **(Figure 3)**.

Overall incidence rates of CTS among senior enlisted and senior officers were more than twice the rates among their respective junior counterparts **(Table 1)**. However, in all age groups, incidence rates were higher among enlisted members than officers; and in service members younger than 40 years, incidence rates were higher among junior than senior enlisted members and among junior than senior officers **(Figure 4)**.

In both enlisted members and officers (and among both males and females **[data not shown]**), those in health care (i.e., "health care specialists" and "health care officers") and administrative occupations (i.e., "functional support and administration" and "administrators") had higher rates than those in any other occupational categories **(Table 1)**. Among enlisted members in "craftsworkers" and "students, trainees, other" occupational groups, incidence rates increased significantly in groups aged 30 years and older **(data not shown)**.

Burden of CTS

During the surveillance period, there were 27,738 incident diagnoses of CTS and 150,617 outpatient encounters attributable to CTS reported from military (77%) and non-military (23%) medical facilities. Annual encounters for CTS increased from 2000 (n=9,092) to 2004 (n=14,527), remained stable until 2009 (n=14,241), then increased in 2010 (n=15,982) **(Figure 5)**. The ratio of encounters per

Figure 2. Incidence rates of carpal tunnel syndrome by service and age group, active component, U.S. Armed Forces, 2000-2010

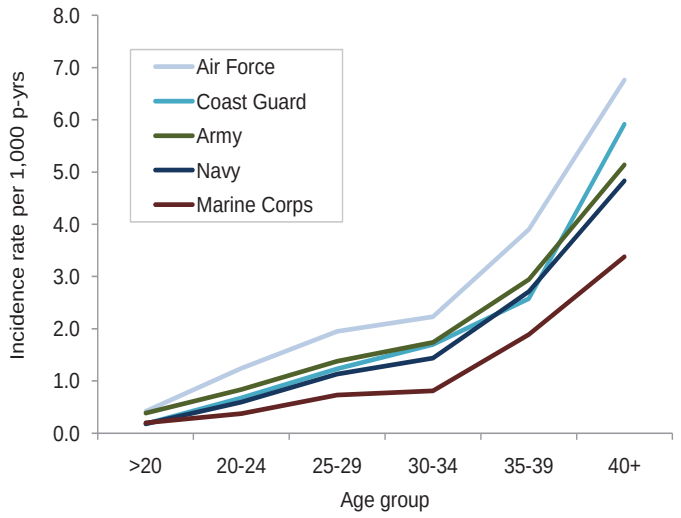


Figure 3. Incidence rates of carpal tunnel syndrome by service and year, active component, U.S. Armed Forces, 2000-2010

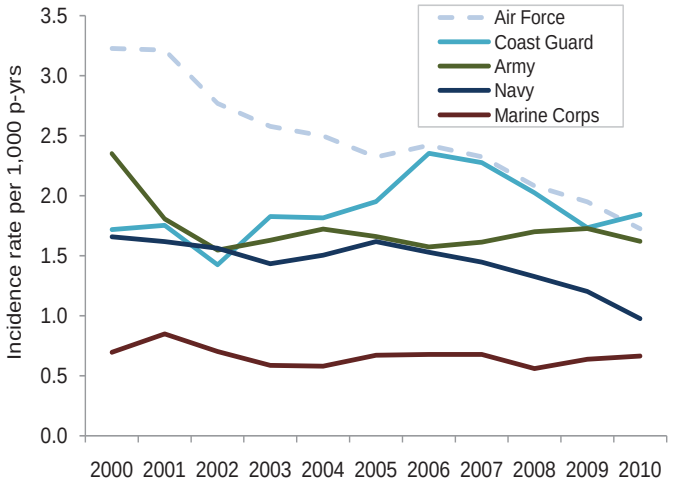
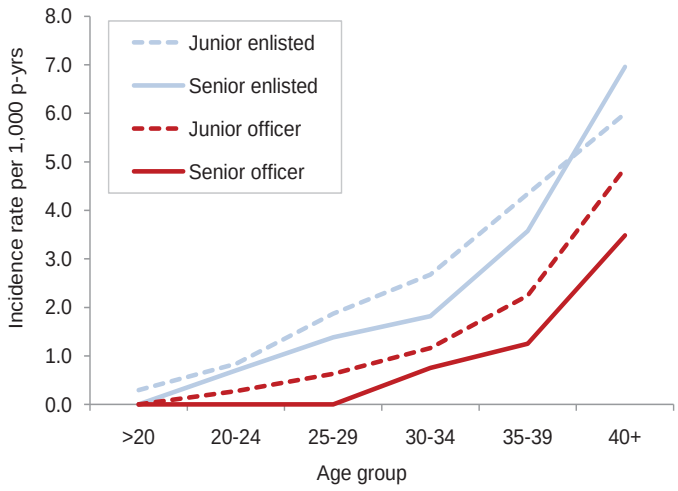


Figure 4. Incidence rates of carpal tunnel syndrome by rank and age group, active component, U.S. Armed Forces, 2000-2010



individuals affected was lowest in 2000 (3.0 encounters per person), remained steady from 2001 to 2009 (range: 3.2 to 3.4 encounters per person), and increased in 2010 (3.8 encounters per person) **(Figure 5)**. Over the entire period, 64 percent of affected individuals had 2-4 encounters each; 22 percent had 5-9 encounters each; 8 percent had 10-14 encounters each; and 6 percent had 15 or more encounters each **(data not shown)**.

Military treatment facilities reported 5,131 CTS-related procedures among 2,628 individuals (9.5% of all cases). Most procedures were carpal tunnel release surgeries (81%, n=4,170); in addition, there were 874 steroid injections (17%) and 87 acupuncture treatments (2%) **(data not shown)**. Of affected service members who were treated with procedures, 55 percent had their procedures within six months of initial diagnosis, 16 percent between six months and one year later, and 30 percent more than one year later **(data not shown)**.

Editorial comment:

This report documents that, over the past ten years, the crude overall incidence rate of CTS diagnoses among active component military members was 1.71 per 1,000 p-yrs; the rate is similar to that estimated in the general U.S. population. During the surveillance period the incidence rate decreased from 2.71 in 2000 to 1.37 in 2010. In general, the incidence rate declines occurred in the demographic and military subgroups with the highest overall rates (i.e., females, Air Force).

Incidence rates reported here are lower than those previously reported in the *MSMR* and another study in U.S. military members.[10,11] This reflects at least in part the stricter case definition that was used for this report; for this analysis, cases required CTS diagnoses during two outpatient visits rather than just one. Despite the differences in case ascertainment methods, the general trends and correlates of risk were similar.

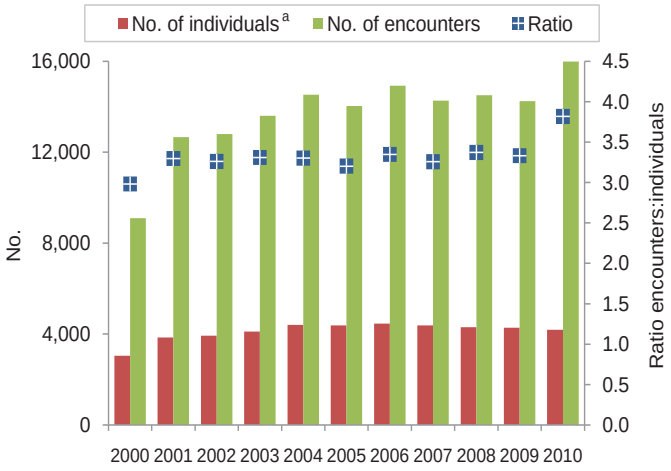
The results of this analysis reiterate the strong relationships between clinically significant CTS and increasing age and female gender. Among both males and females, rates were higher among members of the Air Force, senior enlisted members and senior officers, and those in health care and administrative occupations compared to their respective counterparts. With one exception, after controlling for age, there were not significant differences in CTS incidence in relation to race/ethnicity. It remains unclear as to why black, non-Hispanic females have relatively high rates of CTS.

The relatively high crude rates of CTS among senior enlisted members and officers reflects to a great extent the increased risk that is associated with increasing age; when age differences are accounted for, rates tend to be higher among junior than senior enlisted members and officers. In every age group, rates of CTS are higher among enlisted personnel than officers; the finding likely reflects inherent occupational differences between enlisted members and officers.

Administrative personnel and health care workers (e.g., nurses and dental professionals) who do high force and repetitive bending/twisting of the hands and wrists and use vibrating tools are known to be at relatively high risk of CTS.[1,12,13] Not surprisingly, in this analysis, service members in health care and administrative occupations had relatively high CTS incidence rates. With adjustment for age, enlisted craftsworkers older than 30 years had relatively high CTS incidence rates; the rates in this occupational group were particularly high in those older than 40 years. The craftsworker occupation includes metal workers, welders, machinists, and other industrial-based occupations that have well-documented occupational risk to CTS.[1,3,4,13]

This report should be interpreted with consideration of several limitations. For example, the incidence rates reported

Figure 5. Number of individuals[a] affected by and encounters related to carpal tunnel syndrome by year, active component, U.S. Armed Forces, 2000-2010



[a]Individuals were counted in each year with a CTS medical encounter

here likely are underestimates for several reasons. Clinical manifestations of CTS may not have been identified by health care providers as CTS-related or been reported with CTS-specific diagnosis codes; also, some affected individuals may have completed their military service with no or only a single CTS diagnosis. Numbers of procedures reported here are undoubtedly underestimates because CTS-related procedures were reported only on records of treatments in military medical treatment facilities. In addition, procedure codes that document joint injections and carpal tunnel release surgery are specific for CTS; however, acupuncture is used to treat many conditions other than CTS. Also, this analysis did not capture CTS-indicated treatments involving physical therapy and osteopathic manipulations. Finally, since each affected individual could be counted as an incident case only once during the surveillance period, episodes of contralateral, bilateral, and recurrent CTS were not considered.

In summary, carpal tunnel syndrome remains militarily significant with regard to incidence and burden of health care. Service members affected by CTS can potentially experience symptoms prohibiting them from completing their duties. Interventions should be targeted to those at high occupational risk; in the U.S. military, these groups include service members in health care, administrative support, and craftswork occupations.

Reported by: MAJ Benjamin Palmer, MC, USA

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Herpes Zoster, Active Component, U.S. Armed Forces, 2000-2010

Herpes zoster (HZ), commonly known as "shingles", results from reactivation of latent varicella-zoster virus (VZV) in dorsal root ganglia.[1] Cases of HZ typically present as localized, unilateral vesicular eruptions along nerve pathways with severe pain and numbness in the distribution of the affected nerves.[2,3] The location of HZ presentation is dependent upon the specific nerve in which the reactivation occurs. There is no curative treatment for HZ; however, prompt antiviral administration may shorten the length of the illness and prevent complications.[4,5]

A licensed varicella vaccine directed toward the prevention of primary varicella zoster ("chickenpox") disease was developed in 1995, and made available to the public in 1996.[6] In 1999 the Department of Defense mandated varicella vaccination for all accessions to military service and all health care workers who were determined to be susceptible to infection with VZV.[7]

Both varicella zoster vaccination and the natural acquisition of chickenpox disease establish latency of VZV within dorsal root ganglia – with risk of reactivation and clinical expression as HZ at unpredictable future dates. Depending on the location and severity of the rash, service members can experience debilitating pain and sequelae that can prevent them from conducting their daily duties, particularly in field operational settings. VZV reactivation is thought to be enabled by degraded immune function, and is often positively correlated with stress and increasing age.[1,8]

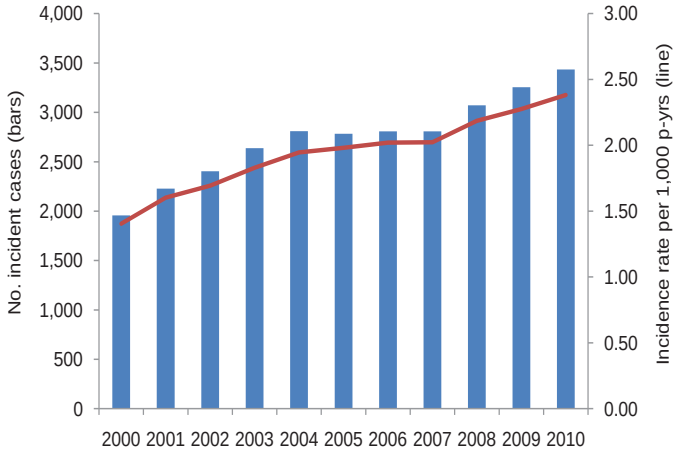
This report summarizes numbers, incident rates, trends, and causes of HZ among active component U.S. military members from 2000 through 2010.

Table 1. Incident numbers and incidence rates of herpes zoster, active component, U.S. Armed Forces, 2000-2010

	No.	Rate[a]	IRR[b]
Total	30,195	1.94	.
Service			
Army	10,103	1.84	Ref
Navy	6,562	1.70	0.93
Air Force	9,281	2.46	1.34
Marine Corps	3,165	1.58	0.86
Coast Guard	1,084	2.55	1.39
Sex			
Male	24,047	1.81	Ref
Female	6,148	2.73	1.51
Race/ethnicity			
White, non-Hispanic	20,399	2.07	Ref
Black, non-Hispanic	4,218	1.54	0.74
Hispanic	2,763	1.77	0.85
Other	2,815	1.99	0.96
Military occupation			
Combat-specific[c]	2,745	1.43	Ref
Armor/motortransport	1,031	1.55	1.08
Fixed-wing pilot	418	2.12	1.48
Helicopter pilot	311	1.96	1.37
Aircrew	453	1.98	1.38
Comm/intel	7,192	2.05	1.43
Healthcare	3,097	2.44	1.70
Other	14,948	1.97	1.37

[a]Rate per 1,000 person-years of active component military service
[b]Incidence Rate Ratio
[c]Infantry, artillery, combat engineering

Figure 1. Incident numbers and incidence rates of herpes zoster by year, active component, U.S. Armed Forces, 2000-2010



Methods:

The surveillance period was 1 January 2000 to 31 December 2010. The surveillance population included all individuals who served in an active component of the Army, Navy, Air Force, Marine Corps, or Coast Guard any time during the surveillance period.

An incident case of HZ was defined as the first medical encounter of each affected service member that was documented with an HZ-specific diagnosis in any diagnostic position. For this analysis, case defining ICD-9-CM diagnostic codes were 053.00-053.11 and 053.14-053.99. Cases were identified from standardized records of hospitalizations and outpatient medical encounters of active component members in military and civilian (purchased care) medical facilities. For purposes of characterizing cases, information on hospitalization records was prioritized over that on ambulatory visit records. Service members who had received diagnoses of postherpetic neuralgia alone (053.12-13), HIV/AIDS, malignant neoplasms, or transplants prior to incident diagnoses of HZ were excluded from the analysis. Rates were calculated as incident HZ diagnoses per 1,000 person-years (p-yrs) of active component service.

Results:

During the 11-year surveillance period, there were 30,195 incident diagnoses of HZ among active component military members **(Table 1)**; the overall incidence rate during the period was 1.94 per 1,000 p-yrs. Nearly all the cases were diagnosed during outpatient visits (99.5%) **(data not shown)**. Overall annual incidence rates increased steadily from 2000 (1.40 per 1,000 p-yrs) to 2010 (2.38 per 1,000 p-yrs) **(Figure 1)**.

Incidence rates increased steadily in each service during the period; however, during each year of the period, HZ incidence rates were substantially higher in the Air Force than in the other services **(Figure 2)**. In general, rates were markedly higher among females than males; and among both males and females, overall incidence rates generally increased with age. Females older than 40 years (3.60 per 1,000 p-yrs) had the highest subgroup-specific overall incidence rate **(Figure 3)**.

The overall rate was relatively high among white, non-Hispanic (2.07 per 1,000 p-yrs) and low among black, non-Hispanic (1.54 per 1,000 p-yrs) service members **(Table 1)**. Across military occupations, crude incidence rates were highest among healthcare workers (2.44 per 1,000 p-yrs), fixed-wing pilots (2.12 per 1,000 p-yrs), and helicopter pilots (1.96 per 1,000 p-yrs) **(Table 1)**.

Of interest, rates were consistently higher during summer than other seasons; for example, during each year of the period, incidence rates and incident diagnoses per 10,000 medical encounters peaked in May, June, July, August or September **(Figure 4)**.

Editorial comment:

This report documents consistently increasing numbers and rates of HZ from 2000 to 2010. During the 11-year surveillance period, the number of incident cases per year increased by 76 percent and the annual incident rate increased by nearly 70 percent.

Direct comparisons of crude rates of HZ (unadjusted for age or other factors) in active military and general U.S. populations are inappropriate. For example, increasing age is a strong correlate of HZ risk, and the general population of the U.S. – but not the military – includes many elderly individuals. Comparisons that are limited to similarly aged individuals suggest that rates of HZ are higher among military members than their civilian counterparts.[9] The relatively higher rates among female and white, non-Hispanic service members compared to their respective counterparts reflect the demographic correlates of risk in the general population.[9,10]

Throughout the period, HZ rates were consistently higher among members of the Air Force than the other services. There are relatively more women and older aged service members in the Air Force than the other services; these

Figure 2. Incidence rates of herpes zoster by service and year, active component, U.S. Armed Forces, 2000-2010

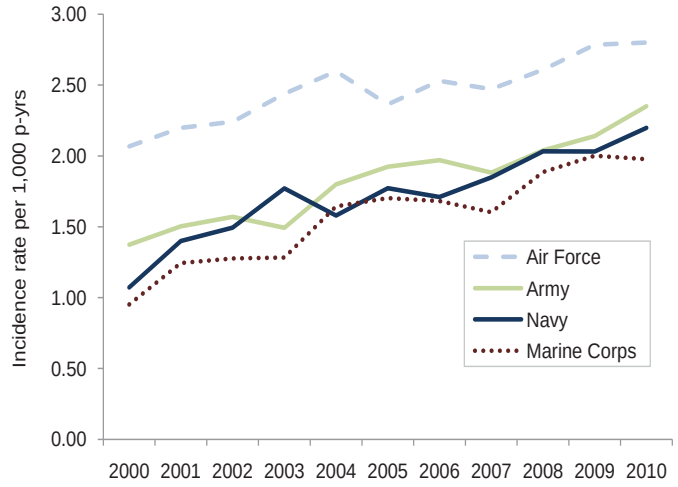
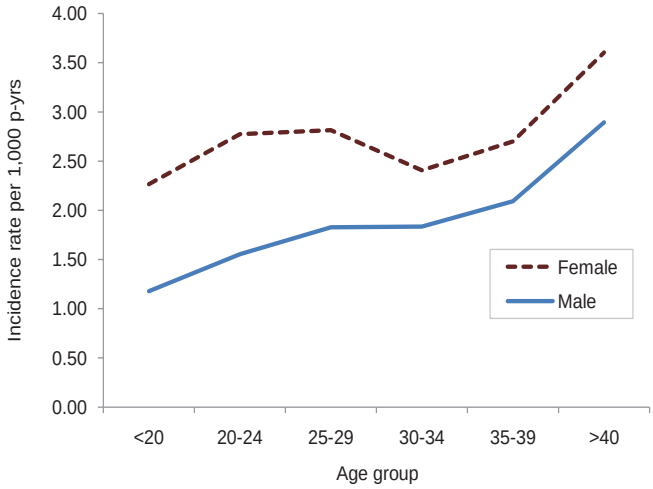


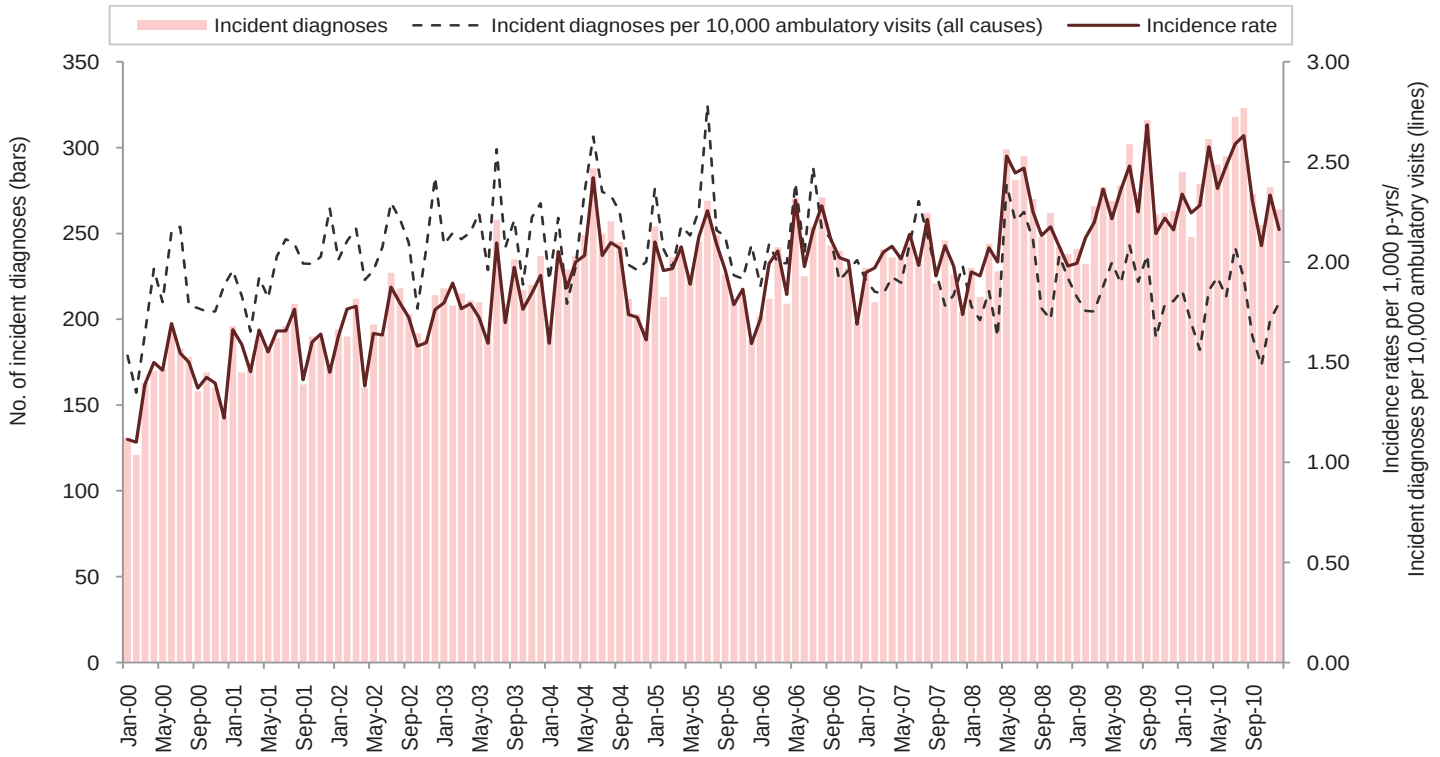
Figure 3. Incidence rates of herpes zoster by sex and age group, active component, U.S. Armed Forces, 2000-2010



demographic differences may explain, at least in part, the relatively high rates of HZ in the Air Force. In addition, however, differences in rates of HZ across the services may reflect differences in the natures and settings of occupational and leisure activities. For example, several studies have suggested that ultraviolet radiation exposure can increase risk of varicella-zoster virus reactivation; if so, Air Force members, and particularly fixed-wing aviators and air crews, would be at increased occupational risk of HZ.[10,11] Seasonal differences in UV radiation exposure may also explain the summer peaks of HZ incidence among military members.

In this analysis, HZ rates declined among women between 30 and 39 years old and leveled off among men between 25 and 34 years old. Many service members in these age groups are parents of young children; and parents of young children may be immunologically boosted against VZV if they are exposed to circulating virus. However, varicella zoster vaccine coverage of susceptible children in the U.S. was estimated as 80 percent in 2002; thus, most children in the U.S. are likely not susceptible to varicella.[12]

Figure 4. Incident diagnoses in ambulatory settings, incident diagnoses per 10,000 ambulatory visits (all causes), and incidence rates of herpes zoster among active component members, by month, U.S. Armed Forces, 2000-2010



The findings of this report should be interpreted cautiously due to several limitations. For example, service members were excluded from the surveillance population if they had ever been diagnosed with conditions that are strongly associated with immunosuppression (e.g., transplants, cancer treatments, HIV/AIDS). As a result, numbers and rates of HZ among military members overall were likely higher than estimated in this report. Also, the analysis was restricted to active component members; because HZ cases that affected reserve component members were not counted, the numbers of cases, associated health care costs, and military operational impacts of HZ are undoubtedly underestimated in this report.

Since 1999, all U.S. military members should have immunity to VZV from natural infection or immunization. Since the DoD's VZV immunization policy was implemented, the burden of disease attributable to chickenpox has markedly declined. However, significant reductions of primary varicella disease decrease exposures of adults to children with varicella zoster and, in turn, lessen natural boosting of immunity to VZV among adults. Reductions of naturally acquired immunologic boosts to VZV may increase risk of VZV reactivation in older adults. Continuing HZ surveillance in military populations may further elucidate the long-term effects of VZV vaccination.

Reported by: Jennifer A. Cockrill, MS, MPH, Epidemiologist,

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Plant Dermatitis, Active Component, 2001-2010

Plant dermatitis is an allergic inflammatory skin reaction in response to the sap of poisonous plants. In the United States, the most common species causing plant dermatitis is the *Toxicodendron* (formerly *Rhus*) species, i.e., poison ivy, poison oak, and poison sumac.[1] In sensitized individuals, responses to the oils of the plants at the sites of exposure produce intense redness and pruritus (itch); severe cases can result in edema, fluid-filled vesicles or bullae, and extreme discomfort. Plant dermatitis is generally self-resolving and lasts approximately three weeks; however, symptoms can persist up to six weeks in highly susceptible individuals.[1] Among military members, plant dermatitis can cause significant disability and lost-duty time.

Toxicodendron species are indigenous to the United States and flourish in forests, fields, wetlands, road sides, parks, and backyards. Poisonous plants are an occupational hazard for U.S. military members who are assigned and train in endemic areas. This report describes the numbers and incidence rates of plant dermatitis in the active component, its seasonality, and its distribution across U.S. military installations.

Methods:

The surveillance period was 1 January 2001 to 31 December 2010. The surveillance population included all individuals who served in the active component of the Army, Navy, Air Force, Marine Corps, or Coast Guard. For this report, a case was defined as one inpatient or outpatient diagnosis of plant dermatitis (ICD-9-CM: 692.6); an individual could be an incident case once every 30 days.

Results:

During the surveillance period, there were 63,206 cases of plant dermatitis (crude incidence rate: 4.4 per 10,000 person-years [p-yrs]) **(Table 1)**. Overall incidence rates generally increased from 2001 to 2010 (3.8 and 4.8 per 10,000 p-yrs, respectively); however, the highest annual rate was in 2006 (5.4 per 10,000 p-yrs) **(Figure 1)**. Incidence rates were higher among males (4.7 per 10,000 p-yrs) and members of the Coast Guard and Army (7.0 and 6.5 per 10,000 p-yrs, respectively) than among their respective counterparts **(Table 1)**. In the Coast Guard, rates of plant dermatitis more than doubled from 2001 to 2010 (3.5 and 9.1 per 10,000 p-yrs, respectively) **(Figure 1)**.

Incidence rates among white, non-Hispanic service members (5.9 per 10,000 p-yrs) were more than five times those among black, non-Hispanic service members (1.1 per 10,000 p-yrs) **(Table 1)**. Rates were also higher among the

Table 1. Incident cases and incidence rates of plant dermatitis, active component, U.S. Armed Forces, 2001-2010

	No.	Rate[a]	IRR[b]
Total	63,206	4.4	.
Sex			
Male	57,728	4.7	1.79
Female	5,478	2.6	Ref
Service			
Army	32,984	6.5	3.10
Navy	7,366	2.1	Ref
Air Force	11,821	3.4	1.63
Marine Corps	8,268	4.5	2.15
Coast Guard	2,767	7.0	3.35
Race/ethnicity			
White, non-Hispanic	53,121	5.9	5.38
Black, non-Hispanic	2,719	1.1	Ref
Hispanic	3,508	2.4	2.23
American Indian/Alaska Native	960	4.0	3.68
Asian/Pacific Islander	1,350	2.1	1.89
Other	1,548	3.6	3.32
Age			
< 20	7,882	5.8	1.51
20-24	21,013	4.3	1.13
25-29	12,169	4.1	1.07
30-34	7,755	3.8	Ref
35-39	6,960	4.0	1.04
40 +	7,427	5.7	1.50
Occupation			
Combat-specific[c]	18,147	8.7	2.82
Motor transport	1,187	4.2	1.36
Pilot/aircrew	2,801	5.2	1.70
Repair/engineering	14,369	3.4	1.10
Communication/intelligence	10,498	3.3	1.06
Healthcare	3,594	3.1	Ref
Other	12,610	4.6	1.51

[a]Rate per 1,000 person-years of active component military service
[b]Incidence Rate Ratio
[c]Infantry, artillery, combat engineering

Figure 1. Incidence rates of plant dermatitis by service and year, active component, U.S. Armed Forces, 2001-2010

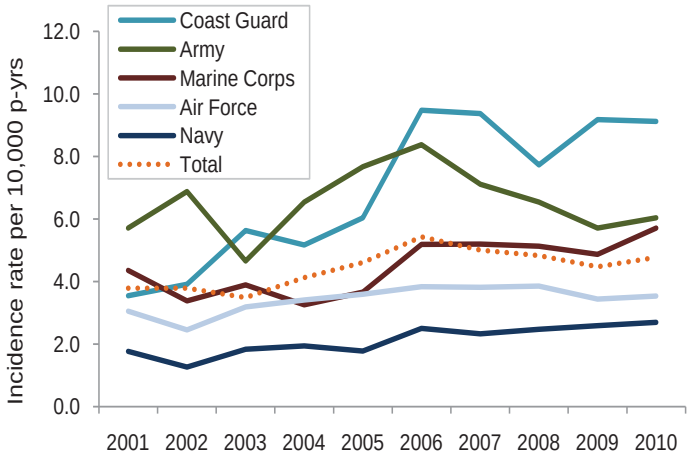
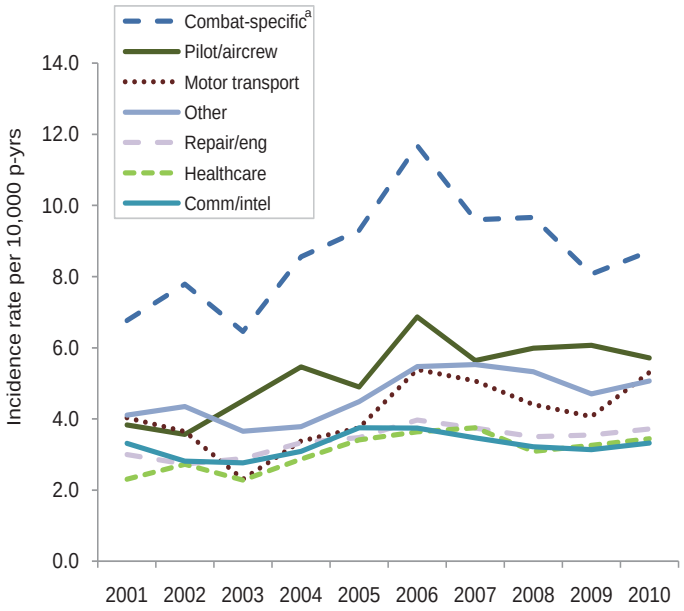


Figure 2. Incidence rates of plant dermatitis by occupation and year, active component, U.S. Armed Forces, 2001-2010



[a]Infantry, artillery, combat engineering

youngest (<20) and oldest (40+) service members (5.8 and 5.7 per 10,000 p-yrs, respectively) than 20-39 year olds. The incidence rate among those in combat-specific occupations (8.7 per 10,000 p-yrs) was more than double the rate among health care workers (3.1 per 10,000 p-yrs); of note, rates in combat-specific occupations increased from 2001 (6.8 per 10,000 p-yrs) to 2010 (8.7 per 10,000 p-yrs) and peaked in 2006 (11.7 per 10,000 p-yrs) **(Figure 2).**

There was distinct seasonality to plant dermatitis incidence; nearly half of the cases occurred during summer months, i.e., June, July and August **(Figure 3).** More cases were diagnosed among service members serving in Georgia (n=12,578), California (n=5,330), and Virginia (n=5,136) than any other states **(Figure 4).** Of all military installations in the U.S., the most cases were diagnosed at Fort Benning, Georgia (n=11,202; 18% of total cases). Of note, peaks of annual numbers of cases of plant dermatitis at Fort Benning generally correlated with reported drought conditions in the Fort Benning area **(Figure 5).**

During the surveillance period, 90 percent (n=50,526) of affected service members had only one plant dermatitis-related medical encounter; 70 service members (>1%) had five or more encounters **(data not shown).**

Editorial comment:

Over the 10 year surveillance period, crude incidence rates of plant dermatitis increased approximately 28 percent. The peak annual incidence rate was in 2006; service members in the Army and in combat-specific occupations (i.e., those with relatively high occupational risk of exposure to toxic plants) were most affected. To some extent, plant dermatitis incidence may be related to weather patterns; for example, moderate drought tends to increase the growth of *Toxicodendron* species.

During drought conditions, water sensitive trees, shrubs, and plants may be overrun by *Toxicodendron* species which are invasive and opportunistic. At Fort Benning, Georgia, the Army's infantry training center, peaks and troughs of plant dermatitis generally correspond with drought and moisture indices during the same years.

It is estimated that 50 to 75 percent of U.S. adults are clinically sensitive to *Toxicodendron* species.[1] This report documented that crude incidence rates of plant dermatitis were more than five times higher among white, non-Hispanic than black, non-Hispanic service members. The finding should be interpreted cautiously because the analysis did not account for potentially confounding differences between racial/ethnic subgroups of service members (e.g., occupational/leisure time activities, medical care seeking behaviors). We are unaware of other studies or surveillance reports that confirm or indicate that there are strong demographic correlates of susceptibility to *Toxicodendron* species.

The youngest (<20 years) and oldest (>40 years) age groups had the highest incidence rates of plant dermatitis. The relatively high rates among the youngest (and most junior and inexperienced) service members may be related to the relatively frequent and intensive exposures to field conditions during recruit and subsequent occupation-specific training.

Among active component members, plant dermatitis cases were most numerous among those serving in Georgia, California, and Virginia and at large training installations in other states. In light of the geographic distributions of *Toxicodendron* species in the U.S., cases in Georgia and Virginia are most likely attributable to Eastern poison ivy, while cases in California are most likely due to poison oak.[2] Not surprisingly, summer months pose the greatest risk of exposure; however, plant dermatitis affects U.S. military members throughout the year.

Approximately one of ten service members who were diagnosed with plant dermatitis had more than one episode

Figure 3. Incident cases of plant dermatitis by month, active component, U.S. Armed Forces, 2001-2010

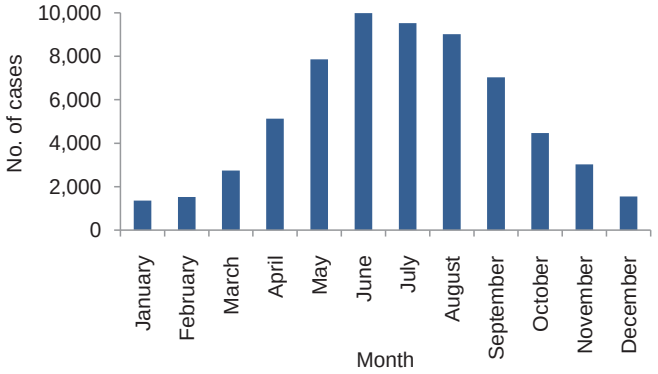
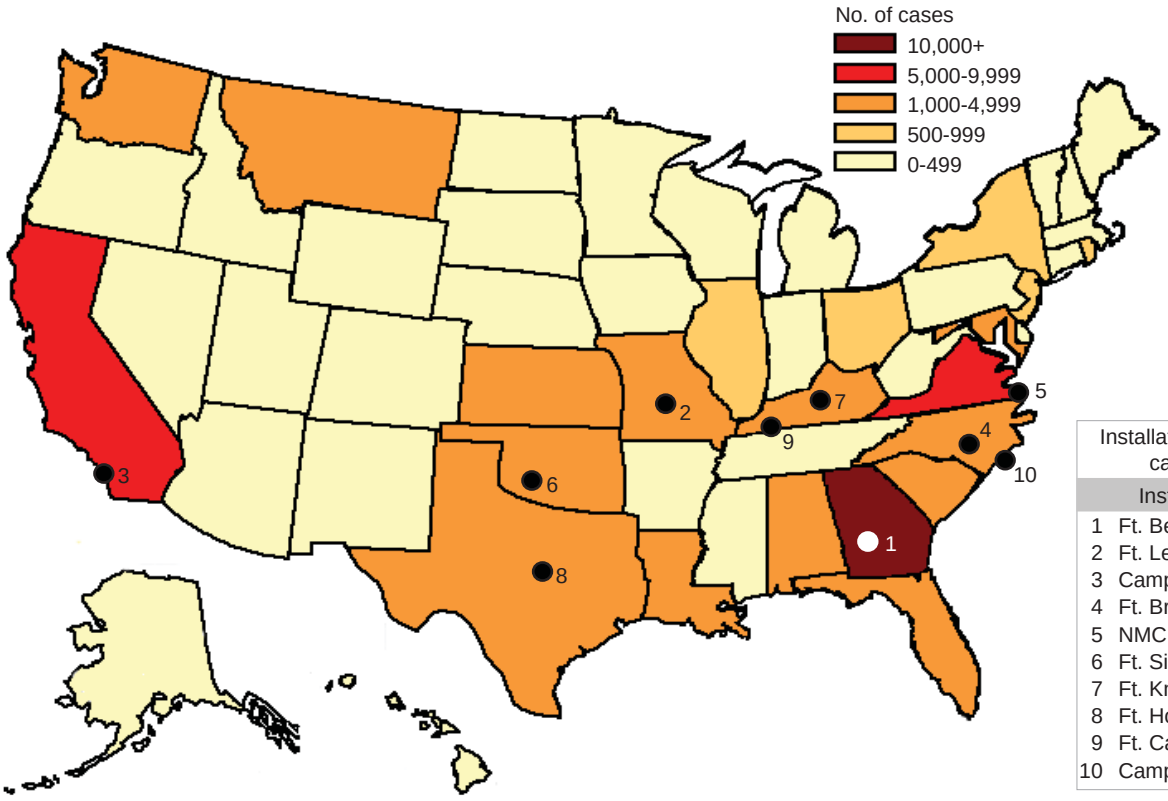


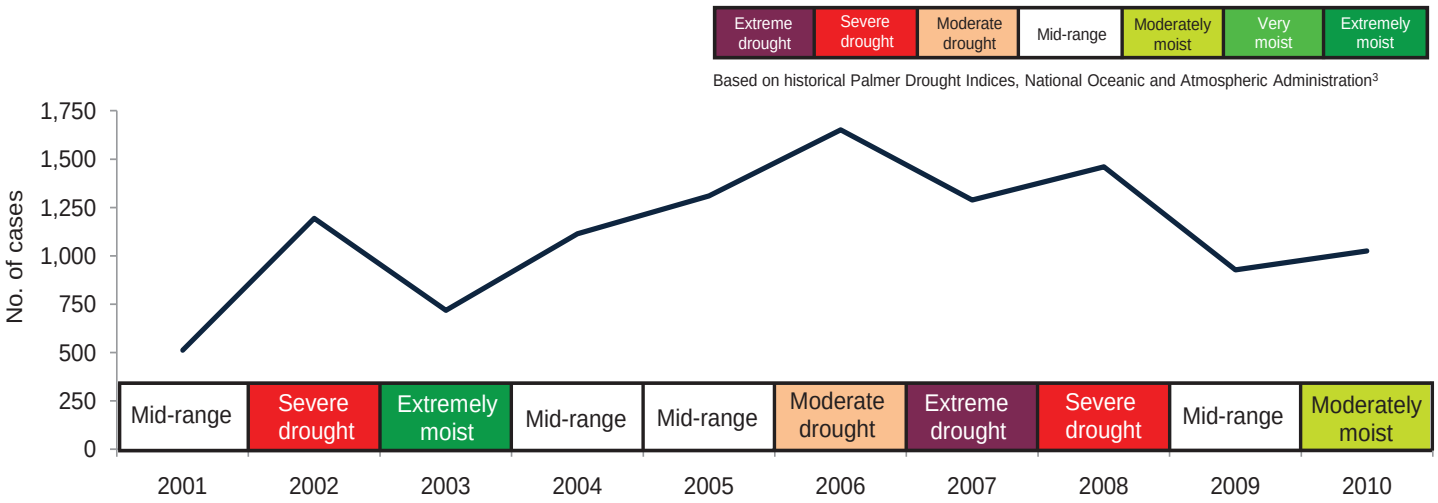
Figure 4. Incident cases of plant dermatitis by state and installations with most reported cases, active component, U.S. Armed Forces, 2001-2010 ***(corrected map as of 19 August 2011)***



Installations with the most reported cases of plant dermatitis

	Installation	State	No.
1	Ft. Benning	GA	11,202
2	Ft. Leonard Wood	MO	3,147
3	Camp Pendleton	CA	3,128
4	Ft. Bragg	NC	2,433
5	NMC Portsmouth	VA	2,063
6	Ft. Sill	OK	1,907
7	Ft. Knox	KY	1,760
8	Ft. Hood	TX	1,618
9	Ft. Campbell	KY	1,591
10	Camp Lejuene	NC	1,375

Figure 5. Number of cases of plant dermatitis at Fort Benning, GA by drought condition in June of each year, 2001-2010



during the period. These "repeat victims" may include individuals who are particularly susceptible to poison ivy. Military members, particularly those in ground combat units, should be informed of the risks associated with exposures to toxic plants and personal protective measures. For example, awareness and concern should be heightened during summer months, particularly during periods of drought. Proper identification, avoidance, and protective clothing are effective preventive measures against plant dermatitis.

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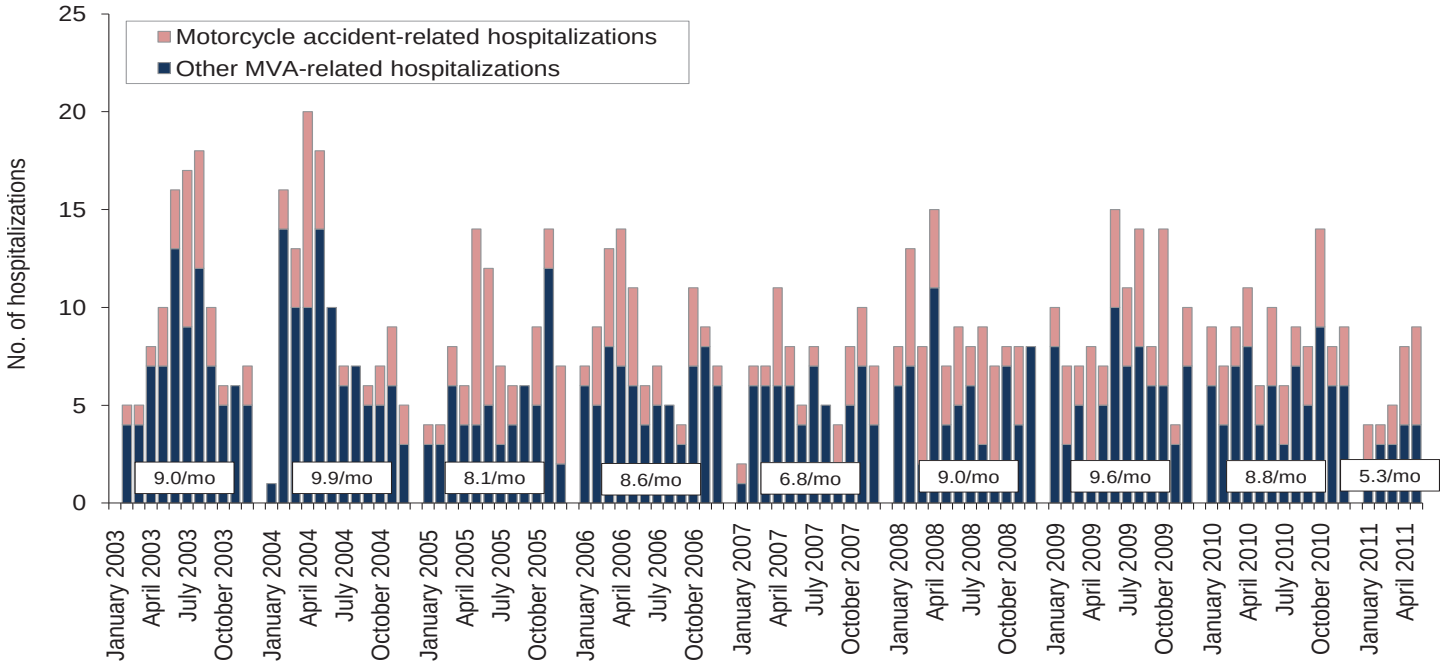
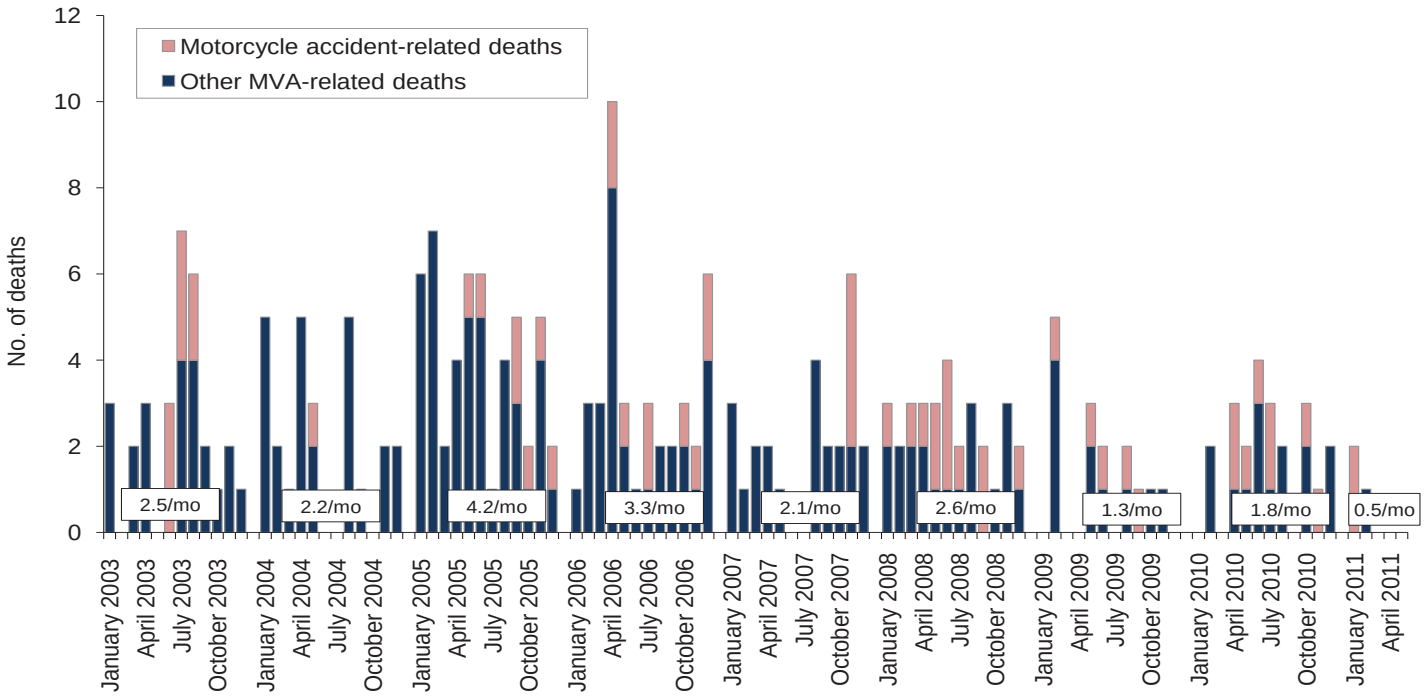
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - June 2011 (data as of 25 July 2011)

Motor vehicle accident-related hospitalizations (outside of the operational theater) (ICD-9-CM: E810-E825; NATO Standard Agreement 2050 (STANAG): 100-106, 107-109, 120-126, 127-129)



Note: Hospitalization (one per individual) while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days of a motor vehicle accident-related hospitalization.

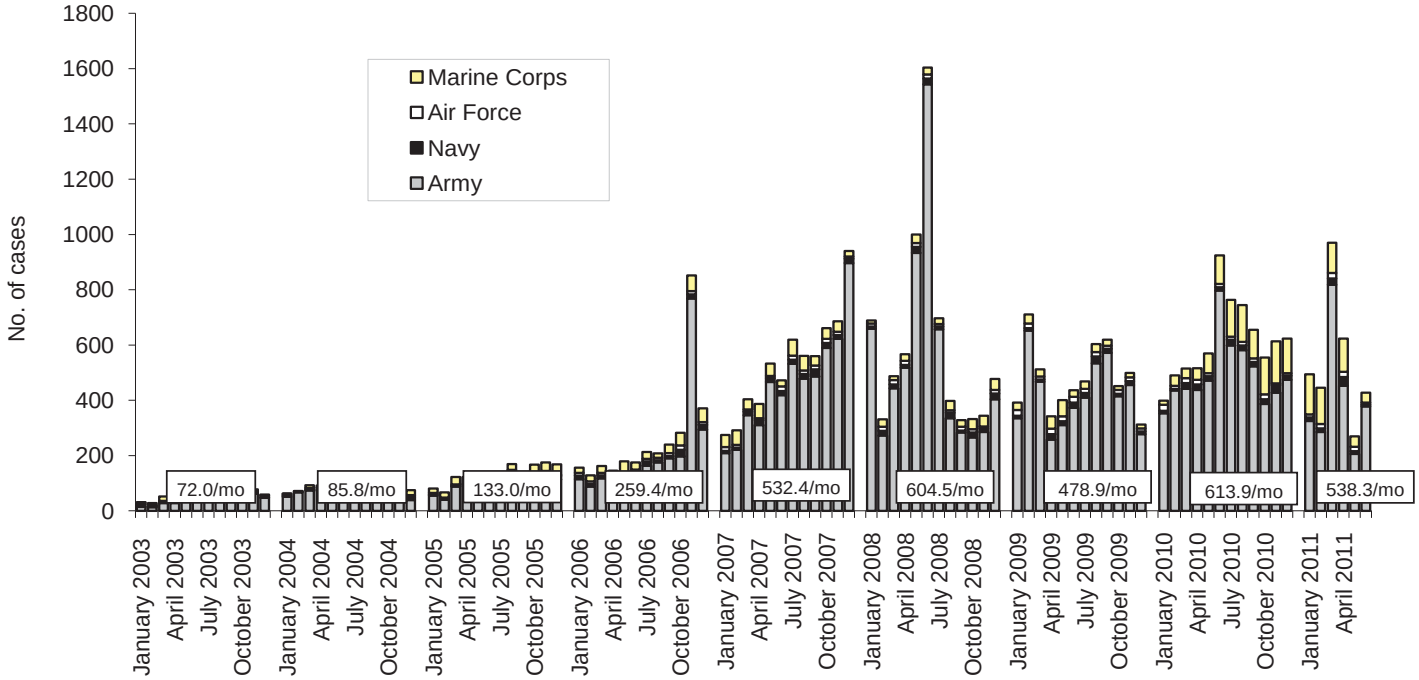
Motor vehicle accident-related deaths (outside of the operational theater) (per the DoD Medical Mortality Registry)



Reference: Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. Armed Forces, 2010. *Medical Surveillance Monthly Report (MSMR)*. Mar 11;17(3):2-6.
Note: Death while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days prior to death.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 -June 2011 (data as of 26 July 2011)

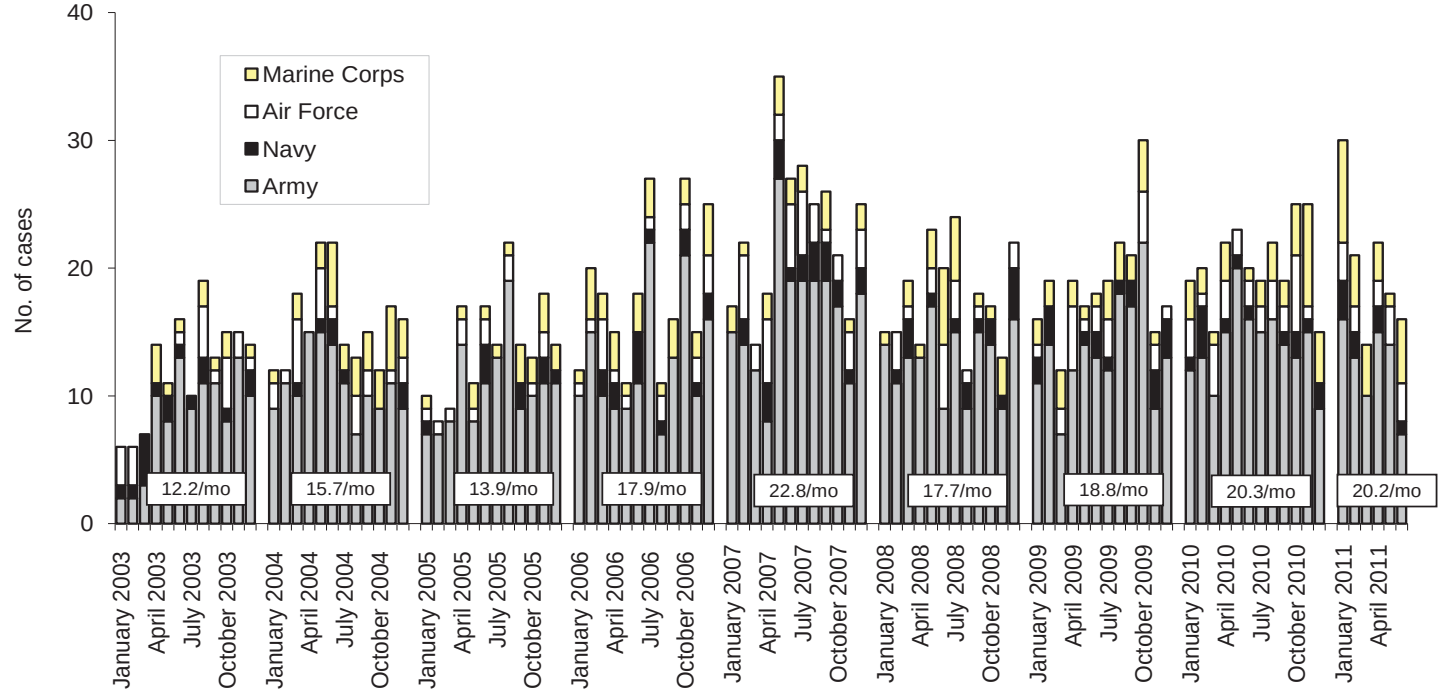
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.59_1-9, V15.59_A-F)[a]



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. Dec 2009; 16(12):2-8.

[a]Indicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 3,084 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF).

Deep vein thrombophlebitis/pulmonary embolus (ICD-9: 415.1, 451.1, 451.81, 451.83, 451.89, 453.2, 453.40 - 453.42 and 453.8)[b]



Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from OEF/OIF.

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